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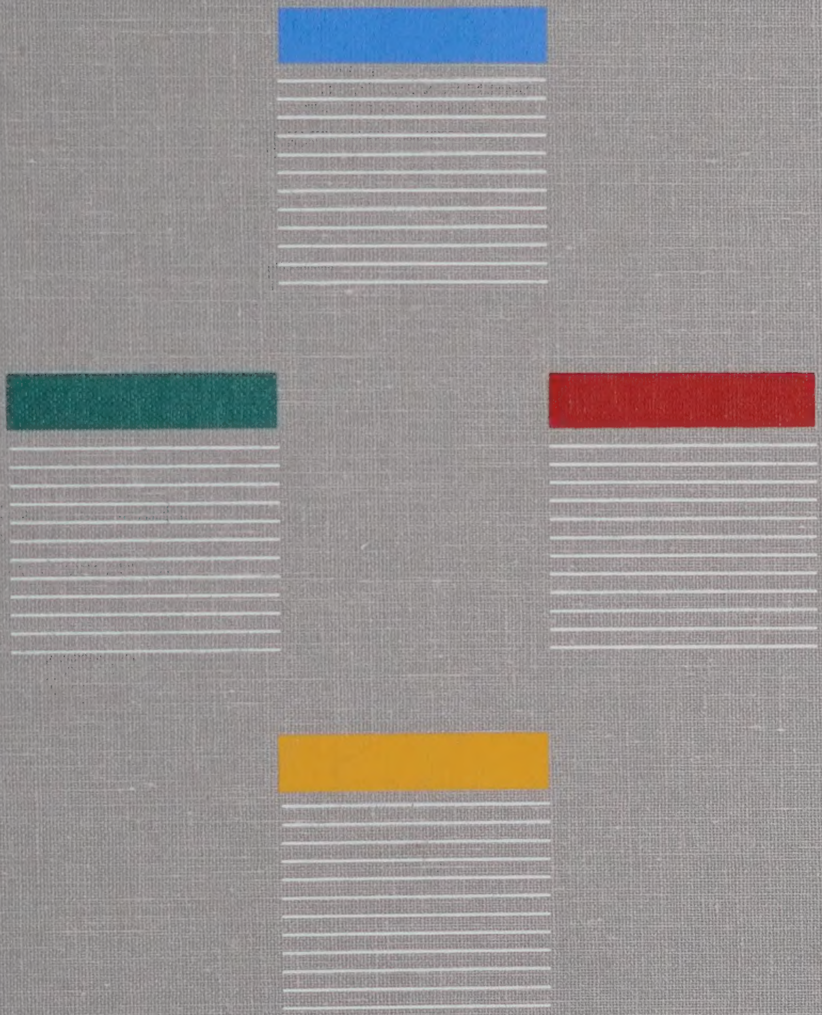

2600 Series Modem User's Manual

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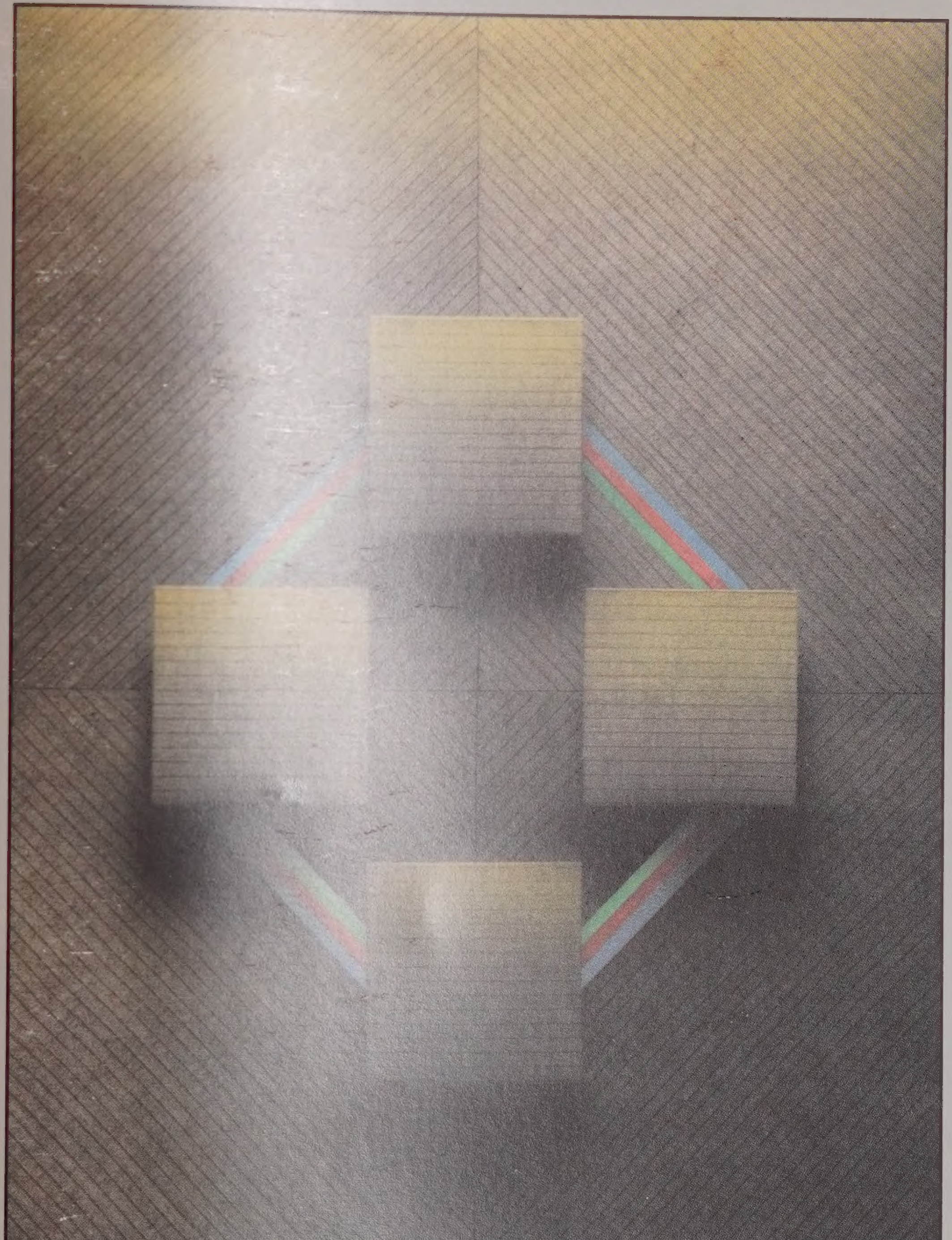

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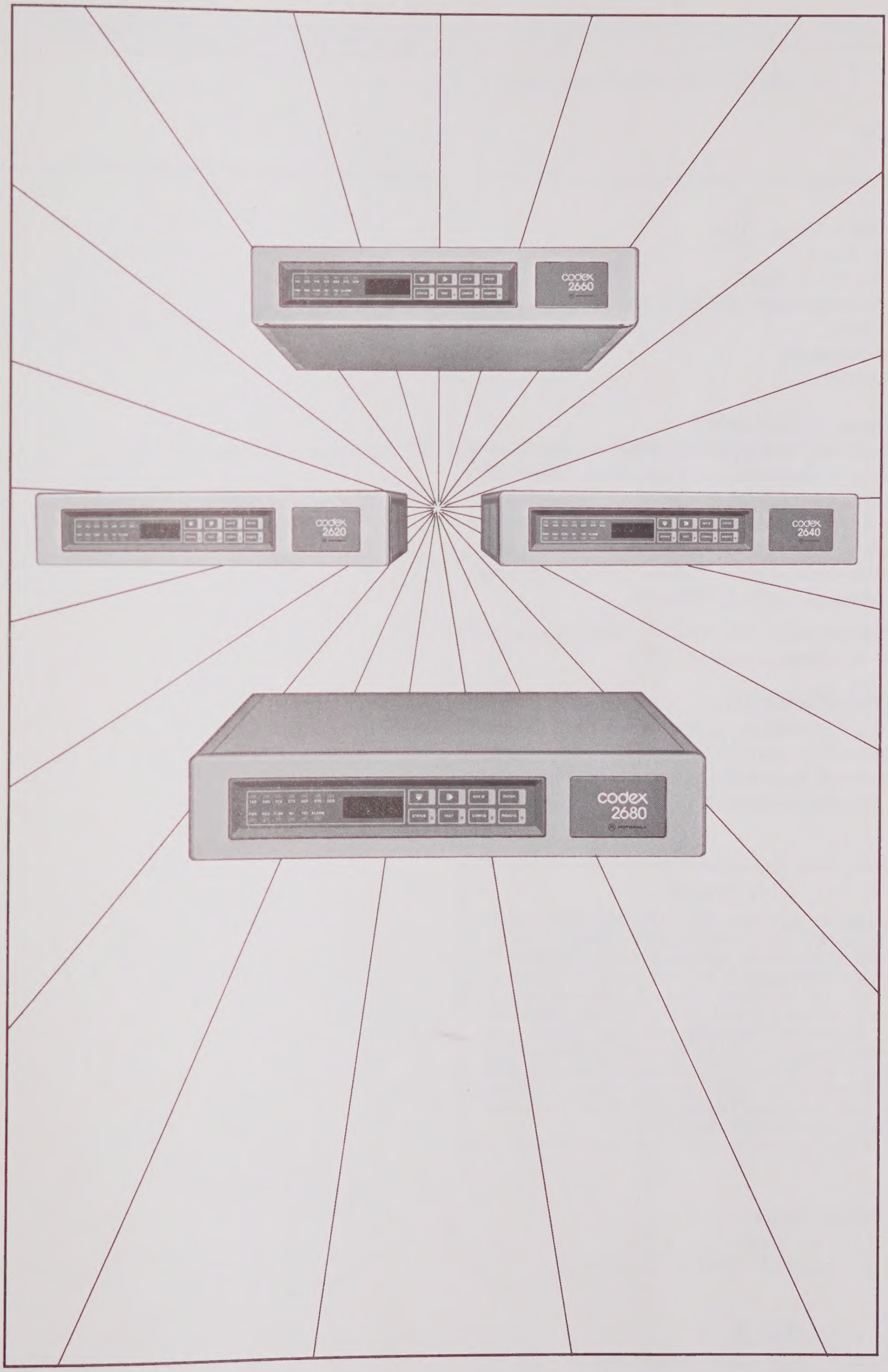
codex 2660
codex 2620
codex 2640
codex 2680

2600 Series Modem
User's Manual

Notice

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User Questionnaire

A prepaid user questionnaire is provided in the back of this manual for your comments. Codex welcomes your comments; your input is important in helping us improve the effectiveness of this manual. Thank you.

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

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Editor: Renee L. Wolff
Production Specialist: Patricia R. Landon

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Revised pages dated 2/88 update this document.
Publication Code LP
First Printing December 1986

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Documentation Change Notice

Part No. 08128-1
March 1987
Page 1 of 1

ADDENDUM 1
2600 SERIES DDR USER'S GUIDE
(Part No. 08128)

GENERAL

This addendum provides revised information and instructions for installing the DDR option. Please make the following modifications to your manual:

Page 4-4

Replace the entire page with the revised copy attached.

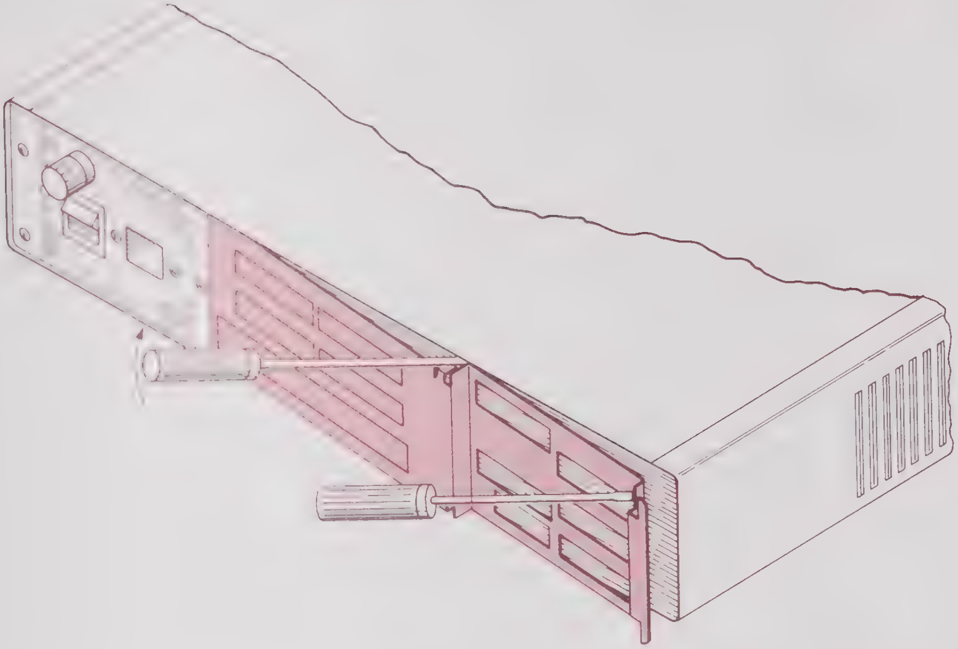

Figure 4-1. Removing the Rear Dress Panel

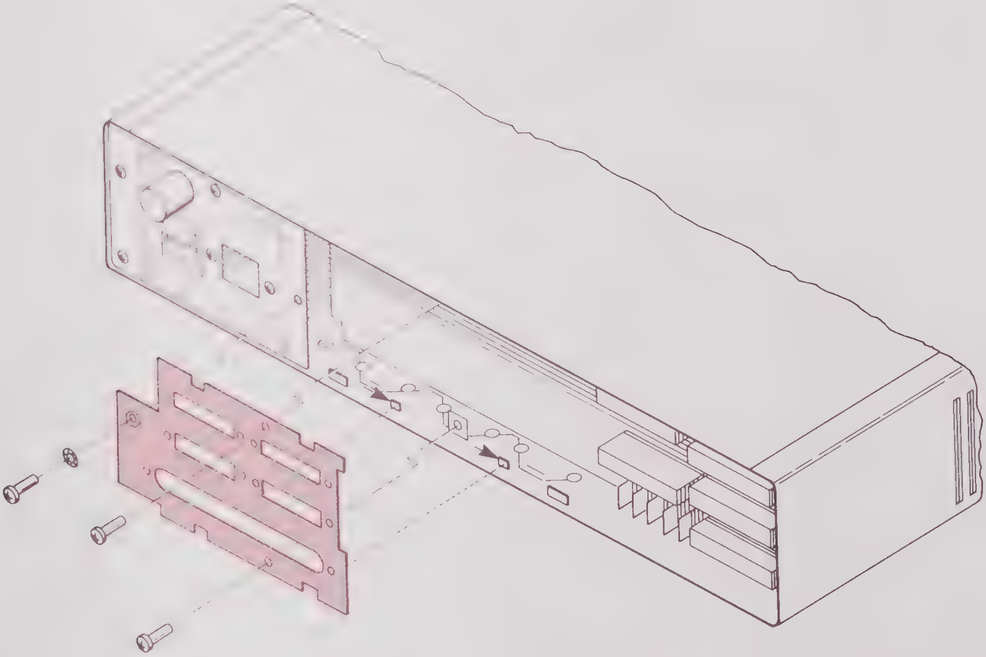

Figure 4-2. Removing the Back Plate

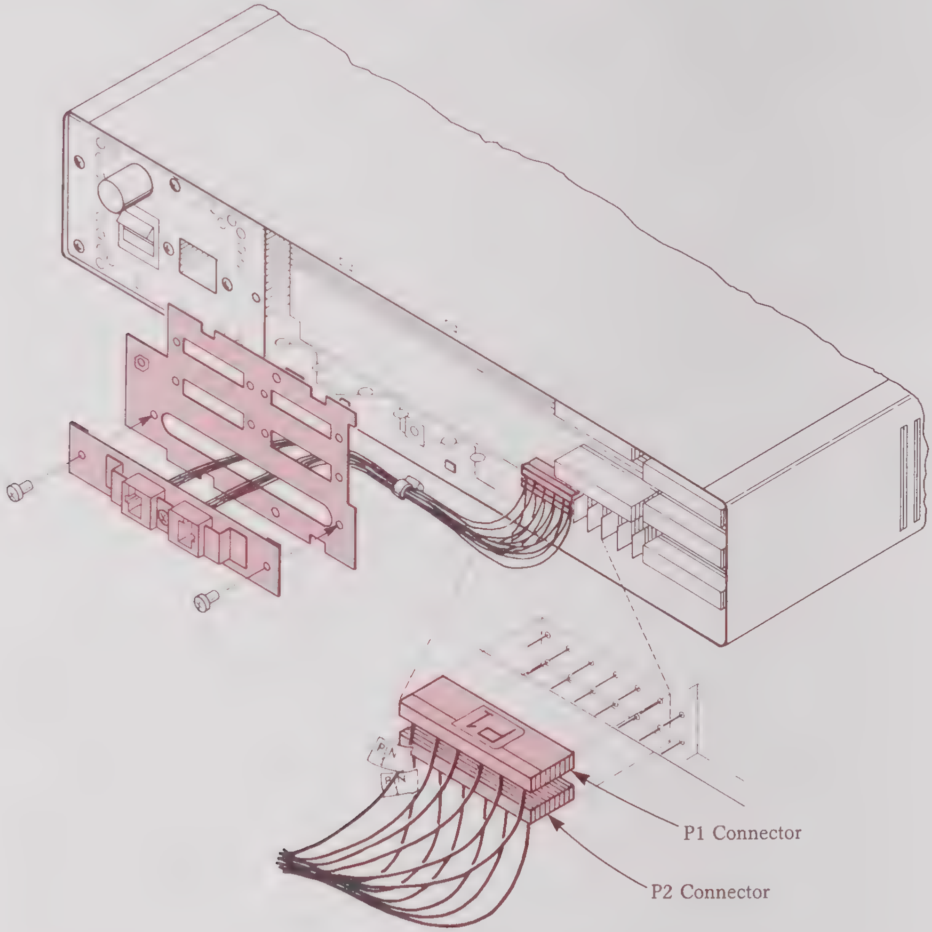

Figure 4-3. Installing the Pin Connectors

8) Plug the two pin connectors on the other end of the cable assembly into the back of the modem as follows (see Figure 4-3):

   - Locate the two rows of pins to the left of the terminal block on the lower right side of the exposed modem backplane.
   - With the wire tagged "P1" on the left, as shown in Figure 4-3, plug the connector P2 into the bottom row of pins within the yellow brackets labeled "DDR OPTION". Repeat this procedure on the top row of pins with connector P1. When both connectors are plugged in, one pin should remain exposed to the right of each connector.

     ■ **CAUTION:** *Leaving more than one pin free to the right of connectors P1 and P2 can cause damage to the DDR card.*

9) Replace the metal backplate and the three securing screws.

10) If your modem has the 6-port Multiplexer Option, refasten the flex cable connectors to the metal back plate with the four hex nuts.

11) Reinstall the rear dress panel.

12) Reinstall all cables.

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Documentation Change Notice

Part No. 08128-2, Rev A
December 1987
Page 1 of 1

DOCUMENTATION CHANGE NOTICE 2
2600 SERIES QUICK CONNECT ENHANCED DUAL DIAL RESTORAL (EDDR)

INTRODUCTION

This notice addresses the Quick Connect EDDR Option and should be used in conjunction with the 2600 Series DDR User's Guide (Part Number 08128, Rev A). ■ **Note:** The Quick Connect EDDR Option (Part Number 31012) is not compatible with other EDDR Options (Part Numbers 31010 and 31011).

The Quick Connect EDDR Option (Part Number 31012) provides for minimum connection time in changing from point-to-point leased lines to temporary dial line transmission.

To minimize the connection time the following changes have been made to EDDR:

- The Validity Check tone has been eliminated from the dial line connection sequence.
- EDDR strap 22(c) sets the callback order for the modems during restoral. If strap 22(c) is set to the default setting of 0 (enabled) the receiving modem will look for its transmit line to be called first. If strap 22(c) is set to 1 (disabled), the modem will accept calls in either order of dialing. See pages 3-4 and 3-5 of the EDDR Manual.
- The Answer-back Tone time and the detection time of the Answer-back Tone have been reduced.

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Documentation Change Notice

Part No. 08155-1
December 1985
Page 1 of 2

ADDENDUM 1
2608 8-MODEM NEST USER'S GUIDE

The 2608 8-Modem Nest uses the following color codes for wires in the audio interface. The information on the following page replaces page 1-5 of the 2608 8-Modem Nest User's Guide.

34-Pin Header (Backplane)	34-Conductor Ribbon Cable		50-Pin Audio Connector (Rear Panel)	Color-Coded Audio Wires
			50 • • 25	Slt/Vlt-Vlt/Slt
			49 • • 24	Brn/Vlt-Vlt/Brn
			48 • • 23	Grn/Vlt-Vlt/Grn
			47 • • 22	Org/Vlt-Vlt/Org
			46 • • 21	Blu/Vlt-Vlt/Blu
			45 • • 20	Slt/Yel-Yel/Slt
			44 • • 19	Brn/Yel-Yel/Brn
			43 • • 18	Grn/Yel-Yel/Grn
17 • • 34	Dummy Pins to Assure Correct Connector Positioning		42 • • 17	Org/Yel-Yel/Org
16 • • 33	Tip and Ring for Receive	Modem 8	41 • • 16	Blu/Yel-Yel/Blu
15 • • 32	Tip and Ring for Transmit		40 • • 15	Slt/Blk-Blk/Slt
14 • • 31	Tip and Ring for Receive	Modem 7	39 • • 14	Brn/Blk-Blk/Brn
13 • • 30	Tip and Ring for Transmit		38 • • 13	Grn/Blk-Blk/Grn
12 • • 29	Tip and Ring for Receive	Modem 6	37 • • 12	Org/Blk-Blk/Org
11 • • 28	Tip and Ring for Transmit		36 • • 11	Blu/Blk-Blk/Blu
10 • • 27	Tip and Ring for Receive	Modem 5	35 • • 10	Slt/Red-Red/Slt
9 • • 26	Tip and Ring for Transmit		34 • • 9	Brn/Red-Red/Brn
8 • • 25	Tip and Ring for Receive	Modem 4	33 • • 8	Grn/Red-Red/Grn
7 • • 24	Tip and Ring for Transmit		32 • • 7	Org/Red-Red/Org
6 • • 23	Tip and Ring for Receive	Modem 3	31 • • 6	Blu/Red-Red/Blu
5 • • 22	Tip and Ring for Transmit		30 • • 5	Slt/Wht-Wht/Slt
4 • • 21	Tip and Ring for Receive	Modem 2	29 • • 4	Brn/Wht-Wht/Brn
3 • • 20	Tip and Ring for Transmit		28 • • 3	Grn/Wht-Wht/Grn
2 • • 19	Tip and Ring for Receive	Modem 1	27 • • 2	Org/Wht-Wht/Org
1 • • 18	Tip and Ring for Transmit		26 • • 1	Blu/Wht-Wht/Blu

Figure 1-4. 2608 8-Modem Nest Audio Interface

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Documentation Change Notice

Part No. 08155-2
April 1986
Page 1 of 1

ADDENDUM 2
2608 8-MODEM NEST USER'S GUIDE
Part No. 08155

This information applies to the section entitled Replacing Modem Cards, on page 3-2 of the *2608 8-Modem Nest User's Guide*.

When you insert the Data Pump and DTE cards into the 2608 8-Modem Nest, you *must* use the following sequence if the power switch is on. If you fail to follow this sequence, you may damage the components of the DTE card.

1) Insert the Data Pump card first, *before* you insert the DTE card.
2) If you remove only the Data Pump card, you *must* unseat the DTE card in the 8-Modem Nest before you reinsert the Data Pump card.

To repeat: You must insert the Data Pump card *first* when the modem is powered on. If you fail to follow this sequence, you may damage the DTE card.

Documentation Change Notice

Part No. 07588-6, Rev A
September 1987
Page 1 of 1

ADDENDUM 6
2600 SERIES DATA MODEM USER'S MANUAL

The Self Test and Self Category sections of your manual state that the Self Test can be executed in either default or continuous mode. However, the Self Test should be used *only* in default mode (run only once), as errors reported in continuous mode may be inaccurate.

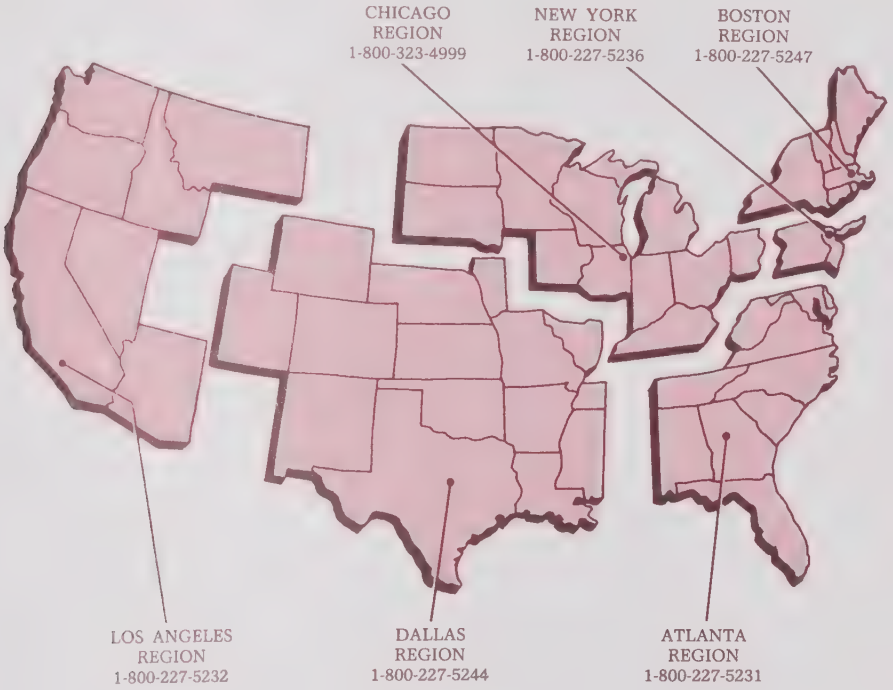
As an alternative to the continuous Self Test, Codex recommends using the Modem Check test in conjunction with external test equipment for long-term testing of the modem.

Please delete references to continuous mode from the Self Category and Self Test sections on pages 2-21, 3-21, and 4-14.

The Modem Check test is described on pages 3-19 and 4-12.

Codex Customer Service

This Reference Guide has been written to help you understand, install, and use your Codex product. For further technical assistance, please contact the Codex Customer Service office in your area during normal business hours. Use the map below to determine the telephone number to call.


CHICAGO REGION 1-800-323-4999
NEW YORK REGION 1-800-227-5236
BOSTON REGION 1-800-227-5247
LOS ANGELES REGION 1-800-227-5232
DALLAS REGION 1-800-227-5244
ATLANTA REGION 1-800-227-5231

Contents

Preface viii

Chapter 1. 2600 Series Overview
Introduction 1-2
Product Features 1-2
Modes of Operation 1-3
Network Management Systems
  Applications 1-4
  Network Control DTE Interface 1-5
  Network Control Channel 1-5
Timing 1-6
  Modem Timing 1-8
  Port Timing 1-9
Loopbacks and Tests 1-11
CCITT V.54 Loopbacks 1-11
Data Pump and Expansion Card Features ... 1-12
  Internal Eye Pattern Generator 1-12
  Control Panel Beeper Disable 1-14
  Power Fail Tone 1-14
  DTE Connector Auxiliary Power 1-14
Specifications 1-15
  Dimensions and Weight 1-15
  Environmental Limits 1-15
  Primary Power Requirements 1-15
  Line Fuse Rating 1-15
  Transmitter 1-15
  Receiver 1-15
  Line Conditioning 1-15
  Digital Interface 1-15
  Operation 1-15
  Network Management System Control
    Channel 1-15
Product Codes 1-16

Chapter 2. Control Panel Features and Trees
General 2-1
Control Panel Description 2-2
Rear Panel Description 2-5
Powering Up 2-6
Control Panel Trees 2-7
  Numerical Data Entry 2-7
  Error Messages 2-9

Contents (continued)

- Status Tree 2-10
  - GENERAL✳ Category 2-11
  - DIAGNOS✳ Category 2-12
  - CQMS✳ Category 2-13
  - PRT SEL✳ Category 2-15
- Test Tree 2-16
  - LOOPBCK✳ Category 2-17
  - CLR TST✳ Category 2-18
  - POLL✳ Category 2-19
  - BER✳ Category 2-20
  - SELF✳ Category 2-21
  - POL RES✳/BER RES✳/SLF RES✳ Category 2-22
- Configuration Tree 2-23
  - MODEM✳ Category 2-25
  - Line Quality Feature 2-32A
  - MUX 1✳ and MUX 2✳ Categories 2-33
  - PORT n✳ Category 2-35
  - NWK CTL✳ Category 2-39
- Remote Tree 2-42
  - Remote Operation 2-43
  - Serial Number/Remote Control Addressing 2-43
  - CONNECT✳ Category 2-44
  - ASSIGN✳ Category 2-45
  - SEARCH✳ Category 2-46
  - MISC✳ Category 2-47
  - MESSAGE✳ Category 2-48
- Configuring the 2600 Series 2-49

Chapter 3. Point-to-Point

- General 3-2
- Point-to-Point Applications 3-6
  - CQMS in Point-to-Point Applications 3-8
  - Point-to-Point Modes with Trellis-Coded Modulation (TCM) 3-8
  - Point-to-Point Codex-Improved Mode (PP CI) 3-10
  - V.33 Point-to-Point Mode 3-10
  - V.29 Point-to-Point Mode 3-10
  - V.27 bis Point-to-Point Mode 3-10
  - Multiplexing Feature 3-10
  - Modem Sharing Feature 3-11
  - Control Signaling 3-17
  - Async-to-Sync Conversion 3-19
- Point-to-Point Loopbacks 3-19
  - Terminal Loopback 3-19
  - Digital Loopback 3-19
  - Modem Check (Analog Loopback) 3-19
  - Audio Loopback 3-19
- Point-to-Point Tests 3-21
  - Poll Test 3-21
  - BER Test 3-21
  - Self Test 3-21
  - Test Tone 3-21
  - Special Control Signal Handling in Loopbacks and Tests 3-22
- Applications 3-23
  - 2680 Modem ARS Advantage 3-23
  - 2660 Modem MSU Advantage 3-24

Chapter 4. Multipoint

- General 4-2
- Multipoint Applications 4-6
  - CQMS in Multipoint Applications 4-7
  - High-Speed Multipoint Modes 4-7
  - MP Mode (Master and Slave) 4-7
  - Codex CS48FP Mode 4-8
  - V.27 *bis* Multipoint Mode 4-10
  - Modem Sharing Feature 4-10
  - Port-to-Channel Mapping 4-10
- Multipoint Loopbacks 4-10
  - Terminal Loopback 4-10
  - Digital Loopback 4-12
  - Modem Check (Analog Loopback) 4-12
  - Audio Loopback 4-12
- Multipoint Tests 4-12
  - Poll Test 4-12
  - BER Test 4-12
  - Self Test 4-14
  - Test Tone 4-14
  - Test Tone 4-14
  - Special Control Signal Handling in Loopbacks and Tests 4-15
- Applications 4-16
  - 2640 Modem and Network Management Systems 4-16
  - 2650 Modem High-Speed Advantage 4-16

Contents (continued)

Chapter 5. Installation and Troubleshooting

General 5-1
Unpacking/Repacking 5-1
Site Selection and Preparation 5-3
Installation Procedure 5-3
  Rack-Mount 5-3
  Electrical 5-6
Installation and Troubleshooting
  Flowcharts 5-13
  Modem Installation Flowcharts 5-13
  Troubleshooting Flowcharts 5-19
  Point-to-Point Trouble Indicators 5-19
  Multipoint Slave Trouble Indicators 5-19
  Multipoint Master Trouble Indicators 5-19
  Voltage Check 5-28

Chapter 6. Maintenance

General 6-1
Repair/Replacement 6-2
  Replacing the Fan Assembly 6-2
  Replacing the Power Supply 6-2
  Replacing Printed Circuit (PC) Cards 6-5

Chapter 7. Return Procedures

Equipment Return Procedures 7-1
  Expiration of Lease 7-2
  Factory Repair 7-2
  Service Replacement 7-2
Questions about Equipment Return
  Procedures 7-2
Repackaging Guidelines for Equipment
  Return 7-2
  Specific Packaging Guidelines 7-3
  Exceptions to Packaging Guidelines 7-3
District and Regional Codex Sales Offices .. 7-3
Regional Codex Customer Service Offices ... 7-6

Glossary

Index

Preface

This manual is a comprehensive guide to all facets of 2600 Series Modem operation. A basic knowledge of data communications is an advantage; however, a new user should be able to learn about specific 2600 Series features and functions.

Chapter 1 introduces the features common to each member of the 2600 Series Modem family, including timing variations, Network Management Systems operations, and product specifications.

Chapter 2 describes the Control Panel and rear panel features and functions. It also provides power-up procedures, tells you how to use the ''Trees'' that take you through modem operations, and provides worksheets on which you can record your settings of your 2600 for future reference.

Chapter 3 discusses in detail the 2600 Series point-to-point modems and their applications. Chapter 4 gives in-depth information on the operation of the multipoint modems in the 2600 Series with applications for network planning. Chapter 5 provides installation and troubleshooting instructions for all the modems. Chapters 6 provides maintenance procedures, and Chapter 7 gives return procedures.

The 2600 Series includes the following models:

2680 Modem—19200 bps, U.S.A. Model
2685 Modem—19200 bps, International Modem
2660 Modem—14400 bps, U.S.A. Model
2665 Modem—14400 bps, International Model
2640 Modem—9600 bps, U.S.A. Model
2645 Modem—9600 bps, International Model
2620 Modem—4800 bps, U.S.A. Model
2625 Modem—4800 bps, International Model

Chapter 1
2600 Series Overview

Contents

Introduction 1-2
Product Features 1-2
Modes of Operation 1-3
Network Management Systems
  Applications 1-4
    Network Control DTE Interface 1-5
    Network Control Channel 1-5
Timing 1-6
  Modem Timing 1-8
  Port Timing 1-9
Loopbacks and Tests 1-11
CCITT V.54 Loopbacks 1-11
Data Pump and Expansion Card Features ... 1-12
  Internal Eye Pattern Generator 1-12
  Control Panel Beeper Disable 1-14
  Power Fail Tone 1-14
  DTE Connector Auxiliary Power 1-14
Specifications 1-15
    Dimensions and Weight 1-15
    Environmental Limits 1-15
    Primary Power Requirements 1-15
    Line Fuse Rating 1-15
    Transmitter 1-15
    Receiver 1-15
    Line Conditioning 1-15
    Digital Interface 1-15
    Operation 1-15
    Network Management System Control
      Channel 1-15
Product Codes 1-16

INTRODUCTION

Codex 2600 Series Modems represent a new generation of technically advanced high-speed modems. Custom VLSI design combine with the processing power of a Motorola 68000 to offer unprecedented performance. With the versatility that allows the expansion of modem operations through optional features and the network capability for creating integrated system applications, the 2600 Series Modems mark outstanding service and reliability.

To provide you with ready access to necessary information, this manual is divided into tabular sections that focus on individual aspects of modem operations, network management, troubleshooting and diagnostic features, installation, and maintenance procedures. In addition, the manual lists product codes and product options available with the 2600 Series.

PRODUCT FEATURES

The 2600 Series Control Panel, standard with all 2600 Series Modems, allows the central-site operator or local user to completely configure, monitor, and test both local and remote modems. The Control Panel remote capability allows you to gain control of any modem in the network by simply entering the address of the remote modem. You can then configure, determine status, and test the remote modem through the local Control Panel. In addition, the Control Panel allows monitoring of major EIA and CQMS (Circuit Quality Monitoring System) line parameters including a single representation of line quality: error probability.

All modem control switches and performance indicators required for local operation of the 2600 Series are located on the Control Panel on the front of the modem. The ''touch sensitive'' switches have a reinforcing audio ''beep,'' which indicates that contact has been made. Visual indicators include LEDs and an alphanumeric display located on the Control Panel. The power switch and all interface connectors are on the rear panel.

Features of the 2600 Series that provide greater reliability, serviceability, and cost savings are summarized below.

- Improvements in signal processing technology yield better performance, giving greater throughput and increased uptime, and resulting in cost savings.
- Operating speed up to 19.2 kbps with adaptive rate adjustment guarantees optimum use of the line, with greater throughput and faster response time.
- 9.6 kbps inbound rate with 17 ms turnaround results in faster polling and response times in multipoint applications.
- Network Management System interface is a standard feature.
- Network Management System channel rates of 75 bps are normally selectable to 110 bps to improve control channel communication speed without reducing customer-available bandwidth. In the 2680 Modem, the embedded network control channel operates at 110 bps.
- The capacity to recognize and use modem serial numbers enables inventory control and network control channel assignments.
- Alarm monitoring is ongoing, including Power Fail Alarm (not applicable to the 2680 Modem) in the event of a slave modem losing power.
- Comprehensive diagnostic tests allow testing of both the line and the modem.
- The ability to accept mixed inbound rates allows greater throughput and faster response times for all slaves in a polling link, thereby optimizing use of existing lines in multipoint applications.
- Binning capacity with Network Management Systems enables specific line fault identification, resulting in faster problem isolation and solution in a polling application.
- The MSU (Modem Sharing Unit) incorporated in the multiplexer option produces line cost savings through sharing of lines.
- Control Panel network control with analog parameter readout allows the operator to monitor and control remote modems.

MODES OF OPERATION

Seven point-to-point operating modes, described in Chapter 3, are utilized in the 2600 Series 2660, 2666, and 2680 Modems. They are the PP 19.2 (64 × 8 TCM), ARS 19.2, PP ARS, PP TCM, PP CI, and the International CCITT V.33 and CCITT V.29. These modes also support multiplexing, and modem sharing features are available.

For multipoint applications, the 2650 offers High-Speed Multipoint Mode (HSMP) and Multipoint Mode (MP). The MP mode, also available on the 2640, supports Mixed Inbound Rates (MIR) and Multipoint Signal Quality Binning (MSQB) features. These features with their applications are described in Chapter 4.

For Codex compatibility, the 2640 (as slave only) and 2620 can be mixed with Codex CS48FP modems on the same line segment. All models of the 2600 Series can be controlled by Network Management Systems. The 2600 Series 2640, 2650, and 2660 also provide end-to-end compatibility with all modems conforming to CCITT V.29 recommendations. The 2620 provides this compatibility with all modems conforming to CCITT V.27 *bis* recommendations (without network control).

When you select an operating mode, the modem automatically sets the appropriate parameters for that application. Because of these automatic parameter defaults, you need not be concerned with the detailed strapping in a common point-to-point or single-tier multipoint application. For example, if you select the PP TCM mode, the modem automatically sets the transmit and receive rates at 14.4 kbps, operates in constant carrier, and enables Round Robin (RR) training for equalization. For all operating modes, the modem automatically selects 0 dBm transmit level, selects low UI (Unattended Initiate) error rate threshold time period, sets leased line carrier detect threshold at −26 to −31 dBm, and so on. You have the option to override these default parameters, if necessary, and reconfigure local and remote modems to your unique application through software strapping via Network Management Systems or the Control Panel.

The 2600 Series can be operated either alone or as part of Network Management Systems. In either case, you can monitor and control remote modems. The only difference is the degree of control. Using only the Control Panel, you can examine, test, and reconfigure the remote modem(s). With a Network Management System, you can do all of the above while maintaining a more comprehensive log of alarms and problem indicators. The choice of level of control is up to you and your specific application.

NETWORK MANAGEMENT SYSTEMS APPLICATIONS

The Codex 2600 Series Modem is best used in a central site Network Management Systems environment. A Network Management System includes a network control port connector, a control channel between modems in the network, and software buffering/switching of control data between the port and the modem network. The 2600 Series uses this system for diagnostic communication between Network Management Systems and the modems.

The Control Panel should be used for initial strapping and addressing, which you should perform before turning the modem over to a Network Management System. At the remote and local sites, you need only do a minimum of connections and configuration before bringing up the link. After both modems are connected to their analog lines and DTEs, a technically knowledgeable person at one end can configure both the local modem and the remote modem. When configuration of the local and remote modems is complete, either Control Panel has the capability to initiate testing of the link. Once it has been established that the link is operating properly, control and monitoring of the link can be turned over to the Network Management System.

While the network is operating, you can use the Control Panel and remote Control Panel feature to monitor, configure, and test the modems on a link. From a Control Panel at one end of the link, you can observe local and remote circuit quality and diagnostic status. You can also check and reconfigure operating mode, multiplexer configuration, and all modem straps in the local and remote modems. This is especially useful before installing a Network Management System or during unavailability of a Network Management System. In addition, you can send messages to the Control Panel of all remote modems. Both a Network Management System and the remote Control Panel can locate devices by serial number, assign network control addresses by serial number, or read the serial number for a specific network control address.

The Network Management System line offers the following operator functions:

- Network Configuration
- Line Configuration
- General Line Information
- Device Alarm Thresholds
- Alarm Monitor
- Condensed Status Displays
- Device Status Displays
- Modem and Line Tests
- Device Backup/Restore
- Utilities
- Codex Management Applications (Codex 4840/4850/4860)
- Connect to DNP (Codex 4840/4850/4860)

Network Control DTE Interface

The DTE interface can be purchased as single channel or as a 4-port or 6-port option. (Only the 4-port option is available in the 2640 and 2620 models.) The multiport options provide for a multiplexing function, a modem sharing function, or a combination of multiplexing and modem sharing.

The 2600 Series provides a separate EIA/CCITT type interface for the network control channel. This interface provides for connection between the modem and the Network Management System hardware and also for interconnection between modems (tiers) in multitier networks. The secondary channel pins of the customer DTE connections are not used.

The network control DTE interface is capable of full-duplex operation but is normally operated in a half-duplex mode.

Network control data transfer is asynchronous at one of the following user-configurable data rates: 75 bps, 110 bps, and 150 bps.

The DTE rate only defines the rate at which the DTE control port operates and does not affect the rate at which the control channel operates. In the 2600 Series, the DTE control port rate and the analog channel rates are totally independent and software-buffered.

The network control DTE interface is configurable for operation at tier boundaries in a DCE/DCE crossover or wired MSU mode. When configured for wired MSU, the DCE-originated interface signals are tri-statable to permit contention operation with polling. When wired MSU operation is not required at a tier boundary, it should be disabled to provide more immunity to noise on the EIA cables.

The 2600 Series network control interface does not include any loopback capability.

Network Control Channel

The 2600 Series includes a control channel dedicated to control communications. This channel is either FSK or embedded modulation. *No user secondary channel is provided.*

Frequency Shift Key Modulation (FSK). The Network Management System Control Channel for the 2620, 2640, 2650, 2660 and 2666 is provided through a low-band FSK channel that operates at speeds of 75, 110, and 150 bps, depending on the main channel mode. Operation is always 4-wire. The modulation is FSK, and two modes (75 and 150 bps) are compatible with those in the CS modems, while the 110 bps mode provides faster operation with 2400 baud main channel operation. The secondary FSK channel is used functionally for Network Management System communications and Power Fail Tone detection.

The secondary FSK channel operation is asynchronous at the following operating speeds:

- 75 bps (set at factory)
- 110 bps
- 150 bps (for use on V.27 *bis* and CS48FP modems only)

The control channel carrier detect for the 2620, 2640, 2650, 2660, and 2666 employs an absolute carrier detect. You can configure the absolute thresholds as shown below:

On	*Off*
−32 dBm	−41 dBm
−41 dBm	−50 dBm

You can set the carrier detect response time as user-configurable at 25 ms or 50 ms.

The normal setting for the FSK Carrier Detect is −41 dBm to −50 dBm. This setting is recommended to guarantee Carrier Detect under all secondary channel signal levels. There may be some situations, however, such as high channel noise or main channel leakage, which would cause an erroneous Carrier Detect on the secondary channel. Under these conditions, the user should select the −32 dBm to −41 dBm thresholds.

When connected directly to the digital ports via hardware bypasses (DCP and FSK rates are the same), the network control secondary FSK channel provides reclocking of the secondary channel receive data stream. The requirement of the reclocking function (or data regeneration) is to remove the timing jitter introduced in the signal before passing the data on to the next tier of the network.

The 2600 Series secondary channel Bit Error Rate is targeted to be better than 10^{-5} at a signal-to-noise ratio (SNR) of 10 dB when operating over unconditioned 3002 lines with the main channel transmitting pseudorandom data as either polled or continuous transmission.

The secondary FSK channel modem check function is implemented only during the local modem power-up or self-test diagnostics. This modem check does not transfer any signals into the secondary channel or any data to the network control DTE connector, and, therefore, prevents the loopback from interfering with network control communications. Main channel modem tests do not affect the secondary channel, so Network Management System communications are not disrupted.

The secondary FSK channel transmit level will always be 6 or 7 dB below the main channel transmit level. The main channel energy is always 1 dB below the maximum transmit level selection so that the main and secondary channel energy will equal the configured transmit level.

Embedded Channel. The advanced 2680 19.2 kbps Modem employs an embedded channel for Network Management Systems. This embedded channel permits the user to have access to the entire 19.2 kbps bandwidth. At the same time it performs all network functions without disrupting main channel data or requiring substitution of the main channel by the control channel for data transmission.

The embedded control channel for the 2680 operates at 110 bps and is independent of the user DTE interface.

Table 1-1.
EIA Timing Designations

EIA Designation	*Pin No.*	*Definition*
DB	15	Transmit Signal Element Timing
DD	17	Receive Signal Element Timing
DA	24	External Transmit Signal Element Timing

TIMING

A common timing element is necessary to transmit and receive data in synchronous modems. You cannot take more bits per second out of the phone line than you are putting in at the other end. Unless the data is accompanied by its own "clock" (a stream of squarewave pulses at exactly the same rate as the data bits), you cannot determine what the data rate is or what information the bits contain. It is this clock that provides the timing reference for the transmission link. The selection of the clock is made using EIA-designated timing definitions, with corresponding pin numbers (see Table 1-1). Bits are clocked out of a DTE device into the transmitter at one end with the DB clock on one EIA interface. They are clocked out of the receiver and into the DTE at the other end with the DD clock on another EIA interface.

Since all clocks are generated using crystals that are slightly imperfect, transmitting and receiving with the same timing element cannot be accomplished without synchronization. When the modem is powered on, the clocks are not rising and falling at the same time—they are out of phase. The modem has a receive tracker and a transmit tracker to advance or retard the phase of its own transmit bit clock or receiver baud clock until it is exactly synchronized with some other source of timing. In the transmitter, for 2600 Series Modems, this source can be DD or DA. If the timing selection is internal, this allows the modem to divide down its crystal output (produce successively lower frequency outputs) directly without any tracking at all. Then the modem uses the DB clock is the result internally, and it use the clock as an available output to some linked data terminal equipment.

The receive tracker in the modem recovers line signaling rate information (baud) from the received data. The tracker aligns its internal baud clock into synchronization with the received timing information. (That is, the divided-down bit clock becomes the baud clock.)

For the transmit tracker, the modem uses the timing pulse from a strap-selectable source (see the TIMING: subcategory in Chapter 2, under the Configuration Tree section) as a reference clock; the transmit tracker will align the internal bit rate clock into phase and frequency with the strap-selected clock. The transmit clock (DB) then goes out on pin 15. (In Figure 1-1, the transmit timing elements are shown as they appear in the modem.) Strap selections are:

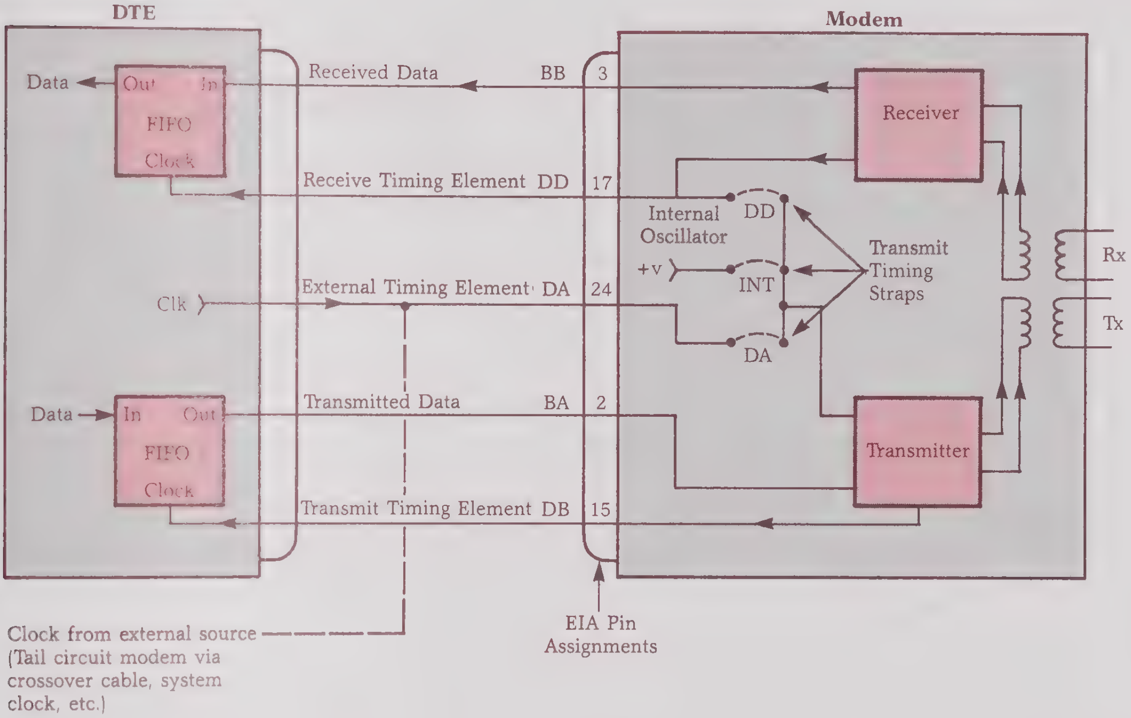

DTE
Modem
Data
Out
In
FIFO
Clock
Received Data
BB
3
Receiver
Receive Timing Element DD
17
Internal Oscillator
DD
Transmit Timing Straps
Rx
+v
INT
Clk
External Timing Element DA
24
DA
Tx
Data
In
Out
FIFO
Clock
Transmitted Data
BA
2
Transmitter
Transmit Timing Element DB
15
Clock from external source (Tail circuit modem via crossover cable, system clock, etc.)
EIA Pin Assignments

Figure 1-1. Transit Clock Sources

- ***Internal Timing.*** The transmit clock (DB). A direct divided-down output from the modem's own internal oscillator. (No tracking.)
- ***Loopback Timing.*** Transmit clock reference (DD), the modem's own receiver clock pulse.
- ***External Timing.*** Transmit clock reference (DA). External clock input on pin 24 from one of the following sources:

  Tail circuit (another modem's DD clock via a crossover cable)

  Station clock (military/commercial)

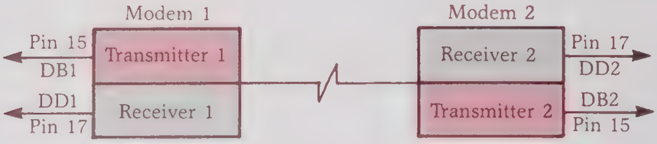
  System clock supplied by the DTE

  Biplexer

  Digital Sharing Device (DSD)

If you do not make a strap selection, the modem defaults to internal timing.

There are two types of timing control that can affect the DB and DD clocks sent to the EIA interface: modem timing and port timing. Modem timing generates the source for the DB clock in the transmitter; port timing accommodates the specific combination of data bits/clocks that should be used at a specific port on the modem to ensure synchronization (that is, sync data, internal clock).



DD1 is synchronized with DB2
DD2 is synchronized with DB1

Figure 1-2. Timing Synchronization

Modem Timing

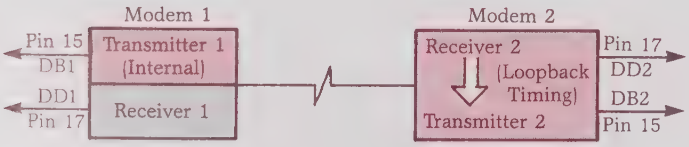
Modem transmit timing selection is part of the TIMING: subcategory on the Configuration Tree (shown in Chapter 2). The timing selection must be made manually.

Internal Timing. Internal timing occurs when the transmit bit clock (DB) is derived within the modem without tracking, directly from the crystal oscillator.

In all single-link multipoint and point-to-point circuits, each transmitter can run on internal timing and each receiver synchronizes itself, deriving timing from the data signal of the transmitter at the other end (see Figure 1-2). This basic timing arrangement permits slight differences in rate between incoming and outgoing data, without slipping bits due to timing variations that can occur. Internal timing in 2600 Series Modems also permits asymmetrical operation with different rates in each direction (for example, fallback in one direction only or mixed inbound rates).

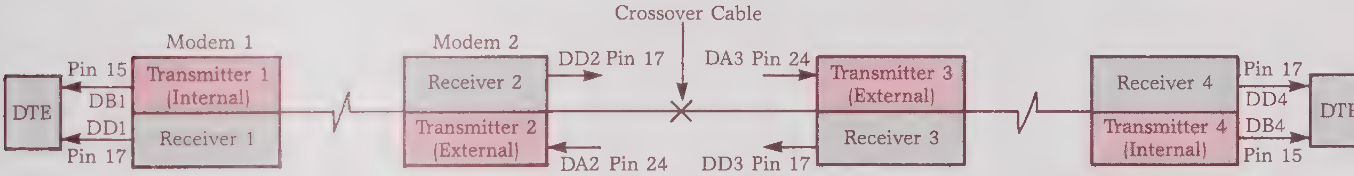
When using single-link point-to-point and multipoint data circuits, no other modem timing arrangement should be necessary.

Loopback Timing. This process assures that no out-of-sync oscillations in the modems on a tail circuit will affect synchronization of the transmitter/receiver or continuous message traffic. Within tail circuits, only *one* clock source is used. Loopback timing causes the transmitter of a slave modem to synchronize its DB clock with the local receiver's DD clock, looping the original clock pulse back to avoid introducing a new clock into the system. All clock pulses are therefore determined by and equal to an original source clock (see Figure 1-3).
■ **Note:** This more complex timing arrangement does not operate with asymmetrical or mixed inbound rates.


Modem 1
Pin 15
DB1
DD1
Pin 17
Transmitter 1 (Internal)
Receiver 1
Modem 2
Receiver 2
(Loopback Timing)
Transmitter 2
Pin 17
DD2
DB2
Pin 15

Receiver 2 gives clock to Transmitter 2.
Transmitter 1 (DB1) is the original clock source for both modem transmitters.

Figure 1-3. Loopback Timing


Crossover Cable
DTE
Pin 15
DB1
DD1
Pin 17
Modem 1
Transmitter 1 (Internal)
Receiver 1
Modem 2
Receiver 2
Transmitter 2 (External)
DD2 Pin 17
DA2 Pin 24
DA3 Pin 24
DD3 Pin 17
Transmitter 3 (External)
Receiver 3
Receiver 4
Transmitter 4 (Internal)
Pin 17
DD4
DB4
Pin 15

DB1 is the Master Clock for the system. DA2 and DA3 become the DB reference clocks.

Figure 1-4. External Timing (Tail Circuit)

Modem External Timing. In multitier and tail circuits, you have to create a single clock reference (a master clock) to synchronize all the transmitters. On the second tier, this timing is external to the modem and is called the DA clock; it comes in on pin 24 via a crossover cable from a colocated DCE (modem). Since a modem can only accept clock on the pin 24 DA clock, a crossover cable must be used in order to pass the received clock of one modem to the transmitter of another modem. For example, in a tail circuit a DCE cannot accept a transmit clock (DB); the crossover cable makes each DCE think the other modem is a DTE, so that the interface can function properly.

The crossover cable carries the DD clock from each receiver to the next modem's transmitter. Each transmitter then retransmits exactly the same clock pulse that the colocated receiver has delivered to it, and a common timing element prevails according to the master clock (see Figure 1-4).

In a multiplexed modem, the external clock source can be selected from one of the mux ports. The external timing selection causes the transmitter to synchronize its internal transmit clock with the clock from the selected port.

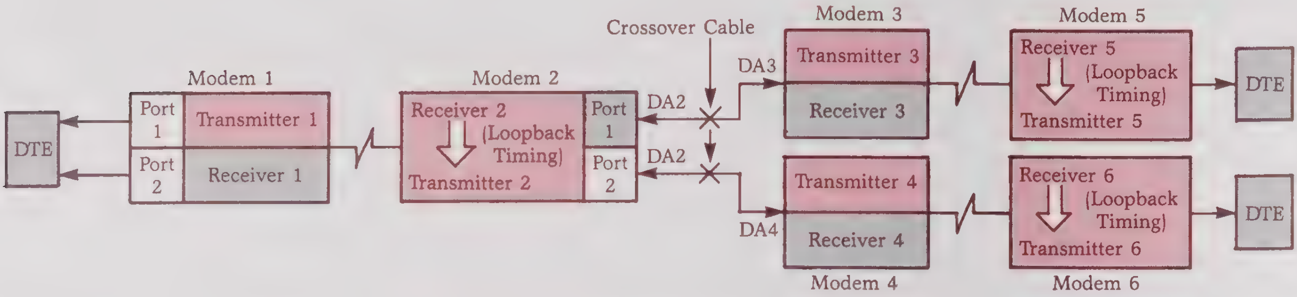
This more complex timing arrangement still permits slight differences between incoming and outgoing rates (asymmetric operation), but it does not permit fallback on one part of the data link without fallback on the other (the port speeds must match).

Port Timing

Port timing selections are found in the Data/Clock area of the Configuration Tree (shown in Chapter 2).

Synchronous/Internal Timing. This is the normal port timing for synchronous ports, indicating sync data with an internal clock. This selection supplies the receiver clock to the port as DD, and the transmitter clock that was selected in modem timing (discussed earlier) is supplied as DB to the selected port. In single-link point-to-point and multipoint data circuits, no other port timing arrangement should be necessary.

Synchronous/External Timing. This timing selection is used for synchronous TDM ports that are connected by a crossover cable to a tail circuit. In this case, *the modem DB timing cannot be external from the port.* Data is clocked into a buffer in the port via the external clock supplied through the crossover cable.



The transmit clock in Modem 1 is the Master Clock.

Figure 1-5. Port Timing

The modem, in turn, clocks the data out of the buffer and into the transmitter according to the selection made in modem timing.

This small buffer (±4 bits) enables the modem to absorb slight timing differences, but the crossover will have occasional bursts of bit errors when the timing slips beyond the buffer's capacity. The only way to avoid timing slips in this arrangement is to select loopback timing at the remote end of the tail circuit and at the transmitter of Modem 2 (see Figure 1-5), as long as this does not violate some other network timing constraint.

Synchronous/Station Timing. This timing selection is used for synchronous ports that are connected by a crossover cable to a Digital Data Service (DDS) unit, which is composed of a Data Service Unit (DSU) and/or a Channel Service Unit (CSU). The DDS/DSU supplies the master clock, so the local modem DB timing must be external from the sync port. The local modem transmitter transmits bits using the DDS clock selected in the TIMING: subcategory on the modem, and the port accepts bits for transmission with the DDS clock. This carries the data through the DD to DA crossover from the DDS/DSU.

In an analog tail circuit, the remote modem recovers timing from the incoming line signal and loops it back to the remote transmitter (which is strapped for loopback timing). The local modem receiver then receives bits from the remote modem using its own DD clock, which is now the same as the DB clock at the remote end. Finally, the port delivers bits with the DDS clock.

Synchronous/Station timing also has a small buffer (±4 bits), which can be enabled to absorb slight timing differences, but the crossover will have occasional bursts of bit errors when the timing slips beyond the buffer's capacity. The only way to avoid timing slips in this case is to select loopback timing at the remote end of the modem circuit, as long as this does not violate some other network timing constraint (see Figure 1-6).

Isochronous Data. This timing selection is used in the rare cases when the DTE clock synchronizes data with its own clock and does not provide a DA clock for the modem to track. The modem transmitter sends bits as selected in modem timing, but the port derives its clock from the data stream itself and accepts bits for transmission through that clock. ■ **Note:** Modem timing should not be external from an isochronous port.

There is a small buffer (±4 bits) to absorb slight timing differences, but this connection will have occasional bursts of bit errors when timing slips beyond the buffer's capacity. There is no way to avoid timing slips in this arrangement.

Asynchronous Data. This is a data/clock selection that is used for async-to-sync conversion and for the transmission of asynchronous data on a synchronous modem or a TDM channel on a synchronous modem. The modem timing can be selected as ASYNC 6D, 7D, 8D, or 9D to meet the needs of the synchronous channels (see Chapter 2).

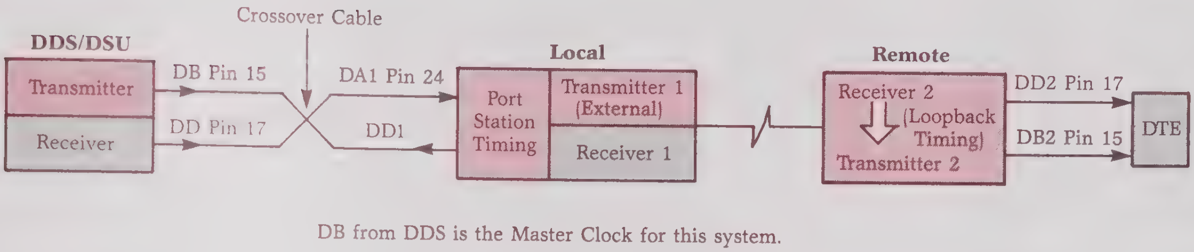


Figure 1-6. Digital Data Service (DDS) with Analog Tail Circuit

Modem timing cannot be external from an asynchronous port. The data is accepted from the asynchronous DTE using a clock derived from the data and centered on the start bits. This process avoids transmitter timing slips by deleting stop bits whenever the async data runs faster than the modem bit clock. At the same time, receiver timing slips are avoided by shaving stop bits when the modem clock runs faster than the async data can be delivered. In both cases, you must strap the port for the correct character length.

LOOPBACKS AND TESTS

Two categories of diagnostic features are included in all 2600 Series Modems: loopbacks and comprehensive tests. The latter are the recommended means of performing system diagnostics. The LOOPBCK✳ Category of the Test Tree (shown in Chapter 2) provides access to all loopbacks. Loopbacks require the use of external test equipment, which simulates the operation of a DTE by sending test patterns and counting bit/block errors. The comprehensive tests are the Poll Test, BER Test, Self-Test, and Test Tone.

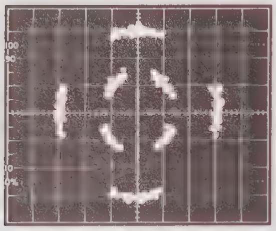
The POLL✳ and BER✳ categories of the Test Tree implement comprehensive end-to-end tests for either multipoint or point-to-point links (note, however, that the Poll Test is not applicable to the 2680). The SELF✳ category implements a modem Self-Test. The Test Tone tests telephone line continuity and is used to measure telephone line attenuation with analog test equipment. The comprehensive test capabilities replace the previous use of Data Clamp in conjunction with loopbacks and provide more quantitative test results. In general, all loopbacks and tests disconnect or interfere with normal data transmission on a portion or all of the network.

All of these tests are explained in detail, according to their applications, in Chapter 3 and Chapter 4.

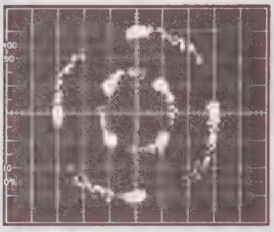
CCITT V.54 LOOPBACKS

The CCITT V.54 Loopbacks are intended for use with special data test sets used primarily in international applications. These test sets control the remote looping and testing of the data circuit via in-band signals. The 2600 Series Modems support two V.54 loopbacks. ■ **Note:** The TEST LED on the Control Panel is not turned on during a V.54 Loop 2 test at the initiating modem. It turns on only at the modem performing the loopback.

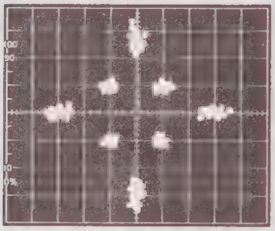
- **V.54 Loop 2.** ***"Simplified Inter-DCE Signaling for Use in Point-to-Point Circuits" (CCITT V.54 Specification, Paragraph 6).*** When enabled in the port straps, the CCITT circuit 140 "On" condition causes a V.54 PN signal to be sent through the channel to initiate a V.54 remote Digital Loopback. The circuit 140 "Off" condition cancels the remote loopback. The CCITT circuit 142 is held On during the remote loopback test phase in accordance with the V.54 specification.
- **V.54 Loop 3.** When enabled in the port straps, the CCITT circuit 141 "On" condition causes a V.54 local analog loopback which is similar to Modem Check. The CCITT circuit 142 is held On during the loopback test phase in accordance with the V.54 specification. Circuit 141 is supported on port 1 only.



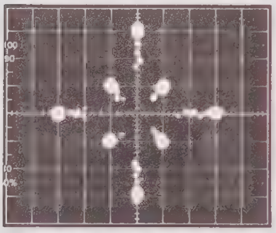
Phase Jitter Distortion. Phase Jitter has the effect of rotating each data point in a radial axis from its normal position.



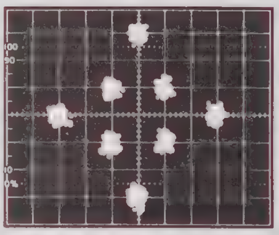
Phase Hits. These have the effect of momentarily rotating the complete pattern by the magnitude of the hit.



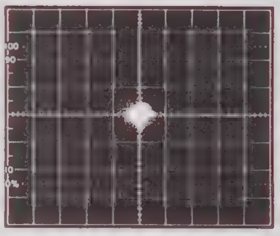
Harmonic Distortion. This tends to spread out the normal data points in a direction predominantly radial to the origin.



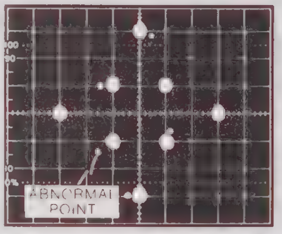
Amplitude Hits. The occurrence of amplitude hits will cause the entire set of normal data points to momentarily expand for a positive amplitude change or contract for a negative amplitude change.



Noise Distortion. The presence of noise on the channel will produce an increase in the size of each normal data point.



Loss of Signal. An absence of any signal will cause the normal data points to collapse to one point located at the origin.



Impulse Noise. The occurrence of an impulse of noise will cause an instantaneous data point at abnormal coordinates.

■ **Note:** 4800 bps/1600 baud (an 8-point pattern) is shown for clarity.

Figure 1-7. Typical EPG Pattern

DATA PUMP AND EXPANSION CARD FEATURES

The Data Pump and Expansion cards have several features that you should be aware of; these are explained in the following paragraphs.

Internal Eye Pattern Generator

The internal Eye Pattern Generator (EPG) is a diagnostic tool used with an oscilloscope to evaluate telephone line performance. It converts equalizer digital inputs to analog voltages that are displayed by the oscilloscope as an "eye" pattern (see Figure 1-7 for typical eye patterns). The number of points appearing in the eye pattern is determined by the bit rate and baud rate of the modem. The display can be analyzed visually for distortions of the telephone line. The internal EPG can be accessed in two ways with the 2600 Series: either via a 3-pin connector located on the front of the Data Pump card (see Figure 1-8) or via the optional Network Management Systems/Oscilloscope to Modem/EPG Cable Assembly (Product Code 31041), which connects to the modem network control port (EIA connector) (see Figure 1-9).

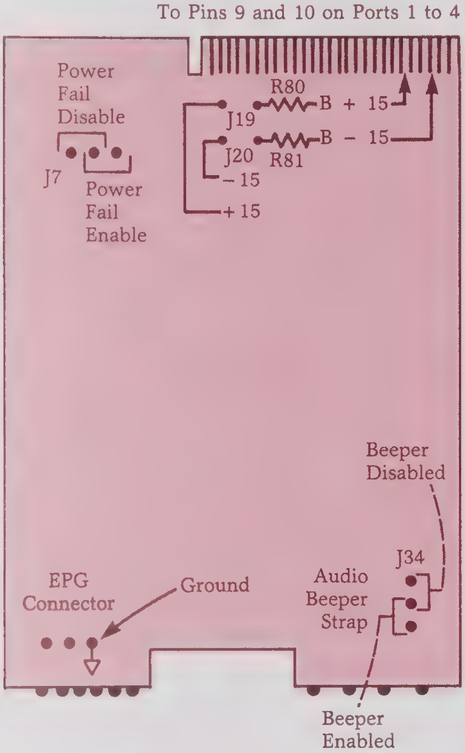

To Pins 9 and 10 on Ports 1 to 4
Power
Fail
Disable
J7
Power
Fail
Enable
R80
J19
B + 15
B – 15
J20
R81
– 15
+ 15
Beeper
Disabled
J34
Audio
Beeper
Strap
EPG
Connector
Ground
Beeper
Enabled

Figure 1-8. Data Pump Card

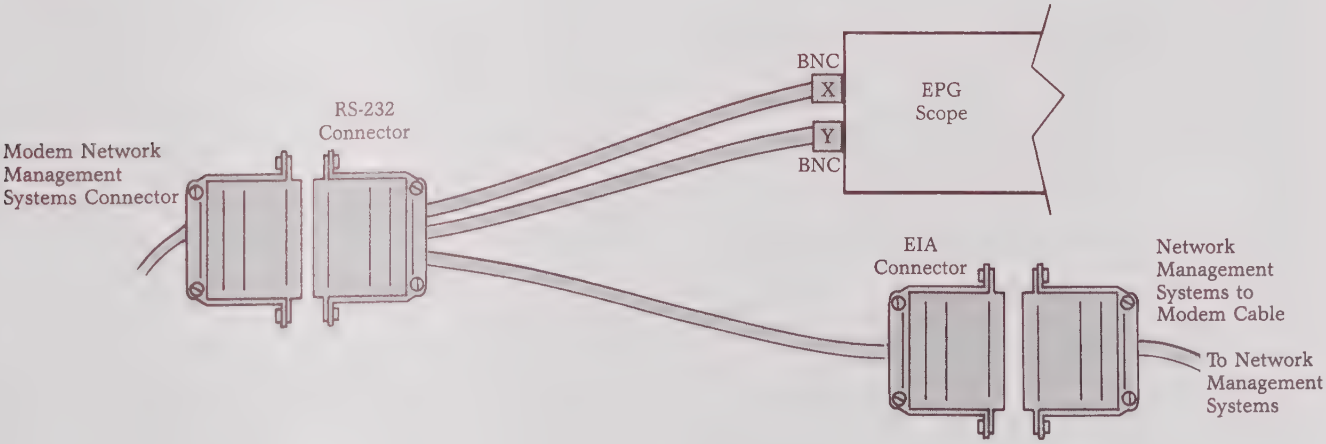

BNC
X
Y
BNC
EPG
Scope
RS-232
Connector
Modem Network
Management
Systems Connector
EIA
Connector
Network
Management
Systems to
Modem Cable
To Network
Management
Systems

Figure 1-9. Network Management Systems/Oscilloscope to Modem/EPG Cable Assembly (Product Code 31041)

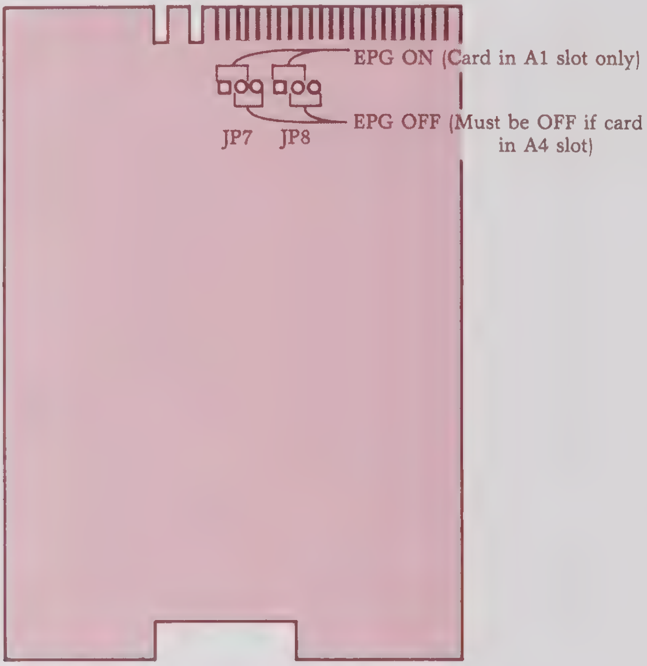

EPG ON (Card in A1 slot only)
EPG OFF (Must be OFF if card in A4 slot)
JP7
JP8

Figure 1-10. 19.2 Expansion Card

The EPG for the 2680 is built into the 19.2 Expansion card, and is available externally (when strapped On) as described above for the 2600 Series. The 19.2 Expansion card can be installed in either the A1 (bottom) slot or the A4 (top) slot of the modem. (If the 19.2 Expansion card has been installed at the factory, you will find the card in the *A1 slot.*) However, if you have purchased the DDR option at the same time, the DDR card must be placed in the A1 slot and the 19.2 Expansion card in the *A4 slot.*

It is important to observe that the EPG straps are configured in the Off position from the factory. The straps should be in the On position *only* if the 19.2 Expansion card is installed in the A1 slot. If the 19.2 Expansion card is in the A4 slot instead, ensure that the EPG straps have been positioned Off (refer to Figure 1-10).

Control Panel Beeper Disable

A 3-pin strap is provided on the Data Pump card in the event that you wish to disable the Control Panel audio beeper (see Figure 1-8).

Power Fail Tone

All 2600 Modems except the 2680 model are equipped with a Power Fail Tone that alerts Network Management Systems when a power failure has occurred. When a modem powers down, it sends a few seconds tone on the line in the FSK band. This tone can be detected as a power fail alarm by the modem at the other end of the line, which passes this information to Network Management Systems. The tone temporarily interferes with network control communications. The Power Fail Tone positively identifies power failure, as opposed to line outage.

A strap (J7) on the Data Pump card (see Figure 1-8) allows you to disable this power fail tone if desired. The modem is shipped with this strap enabled.

DTE Connector Auxiliary Power

Straps J19 and J20 on the Data Pump card (see Figure 1-8) control ±15 volts to pin numbers 9 and 10 on DTE ports 1 through 4 and are for use by external auxiliary equipment. These straps are usually left Out unless power is required by external devices, such as the Codex Modem Substitution Switch, connected to the ports.

SPECIFICATIONS

Dimensions and Weight

- ***Height:*** 3.5 in. (8.9 cm)
- ***Width:*** 17 in. (43.2 cm)
- ***Depth:*** 16.75 in. (42.5 cm)
- ***Weight:*** 20 lb (9.1 kg) without options

Environmental Limits

Operating Conditions

- ***Temperature:*** 0° to 50°C (32° to 122°F); maximum rate of change 20°C (68°F) per hour.
- ***Relative Humidity:*** 5 to 95% (noncondensing).
- ***Altitude:*** 10,000 feet (3048m) maximum.
- ***Vibration:*** .25g force at 30 Hz (commercial/office); .50g force at 500 Hz (light industrial).
- ***Electrostatic Discharge:*** 11 kV with no errors.
- ***Radiated/Conducted Emissions:*** Performance to FCC Part 15 Class A. Shielded modem to DTE and modem to DNCS cable must be used.

Nonoperating Conditions

- ***Temperature:*** −40° to +70°C (−40° to +158°F)
- ***Humidity:*** 0 to 95% (noncondensing)
- ***Altitude:*** 0 to 50,000 feet
- ***Shock and Vibration:*** In approved shipping container, conforms to the requirements of the National Safe Transit Association Preshipment Test Specifications.

Primary Power Requirements

- 90 to 130 VAC ±10%, 47 to 63 Hz, 45W maximum (without options)
- 230 VAC ±10%, 47 to 63 Hz, 45W maximum (without options)

■ **Note:** Power requirements for the 2680 Modem use a 55W maximum.

Line Fuse Rating

3A (Slo-Blo) for 90 to 130 VAC

1.6A (Slo-Blo) for 230 VAC

Transmitter

- ***Output Level:*** Selectable from 0 to −15 dBm in 1 dB steps. International models are factory-selectable per PTT requirements.
- ***Output Impedance:*** 600 ohms, resistive, balanced
- ***Transmitter Timing:*** Internal, external, or loopback

Receiver

- ***Dynamic Range:*** −6 to −40 dBm
- ***Input Impedance:*** 600 ohms, resistive, balanced

Line Conditioning

Line conditioning requirements depend on the operating mode and are defined in Tables 3-2 and 4-2.

Digital Interface

Digital interface conforms to EIA 232-C and CCITT V.24/V.28 requirements.

Operation

- Full-duplex synchronous/asynchronous binary serial data transmission
- ***Primary Data Rates:*** 19.2, 14.4, 9.6, and 4.8 kbps
- ***Audio Signaling Rates:*** 2743, 2400, 1600, and 1200 baud

Network Management System Control Channel

- ***Modulation Type:*** FSK (Frequency Shift Keying); embedded channel
- ***Data Format:*** Asynchronous, serial by bit
- ***Data Rates:*** Selectable from 75, 110, 150 bps, depending on main channel speed (factory-set at 75 bps). 150 bps is only usable with 1600 or 1200 baud modes (i.e., CS48FP and V.27 *bis).* Only 110 bps is used for the embedded channel.

■ **Note:** Unless otherwise indicated, all references to FSK and embedded control channels will be designated simply as ''control channel.''

PRODUCT CODES

Table 1-2.
Product Codes for 2600 Series (Domestic) Modems and Options

Model Number	*Product Code*	*Description*
2680	32681	19.2 kbps, point-to-point modem, with dual channel
2680	32684	19.2 kbps, point-to-point modem, with 4-channel multiplexer option
2680	32686	19.2 kbps, point-to-point modem, with 6-channel multiplexer option
2660	32561	14.4 kbps, single-channel, point-to-point modem
2660	32564	14.4 kbps, point-to-point modem, with 4-channel multiplexer option
2660	32566	14.4 kbps, point-to-point modem, with 6-channel multiplexer option
2650	32651	14.4 kbps, multipoint modem, with single channel
2650	32654	14.4 kbps, multipoint modem, with 4-port modem sharing unit option
2650	32656	14.4 kbps, multipoint modem, with 6-port modem sharing unit option
2640	32641	9.6 kbps, single-channel, point-to-point or multipoint modem
2640	32644	9.6 kbps, point-to-point or multipoint modem, with 4-channel multiplexer option
2620	32621	4.8 kbps, single-channel, point-to-point or multipoint modem
2620	32624	4.8 kbps, point-to-point modem, with 4-channel multiplexer option
	Options	
	31004	4-channel mux upgrade kit
	31006	6-channel mux upgrade kit
	31020	Integrated Dual Dial Restoral unit
	31030	Rack-mount kit
	31061	Communications Test Equipment
	31054	Communications Test Equipment with Integrated Dual Dial Restoral unit
	32600	2608 8-Modem Nest
	23340	15-ft (4.6m) DNCS to modem cable
	23342	30-ft (9.1m) DNCS to modem cable
	23344	50-ft (15.2m) DNCS to modem cable
	31041	Network Management System/Oscilloscope-to-modem/eye-pattern-generator cable assembly
	31042	829 Adapter with a modular interface
	31043	Modem to standard CS cable interface
	47026	15-ft (4.6m) modem to telephone line (spade) cable assembly
	99055	7-ft (2.1m) modem to telephone line (modular) cable assembly
	99056	14-ft (4.3m) modem to telephone line (modular) cable assembly

Table 1-3.
Product Codes for 2605 Series (International) Modems

	2625 (4.8 kbps)		*2645 (9.6 kbps)*		*2665 (14.4 kbps)*		*2666 (V.33)*		*2685 (19.2 kbps)*
	NRO	**Basic**	**NRO**	**Basic**	**NRO**	**Basic**	**NRO**	**Basic**	**NRO**
220 VAC									
1-channel	32421	32521	32441	32541	32451	32551	32457	32452	32283
4-channel	32424	32524	32444	32544	32454	32554	32458	32453	32285
6-channel	N/A	N/A	N/A	N/A	32456	32556	32459	32455	32287
220 VAC UK									
1-channel	32821	32921	32841	32941	32861	32961	32957	32952	32981
4-channel	32824	32924	32844	32944	32864	32964	32958	32953	32984
6-channel	N/A	N/A	N/A	N/A	32866	32966	32959	32955	32986
110 VAC									
1-channel	32221	32321	32241	32341	32251	32351	32462	32467	32583
4-channel	32224	32324	32244	32344	32254	32354	32463	32468	32585
6-channel	N/A	N/A	N/A	N/A	32256	32356	32465	32469	32587

Table 1-4.
Product Codes for 2605 Series Options

Product Code	*Description*
2625	
31014	Mux upgrade kit (4-channel)
31020	Internal DDR (FCC)
31022	NRO upgrade kit
31030	Rack mount
2645	
31014	Mux upgrade kit (4-channel)
31020	Internal DDR (FCC)
31024	NRO upgrade kit
31030	Rack mount
2665	
31014	Mux upgrade kit (4-channel)
31016	Mux upgrade kit (6-channel)
31020	Internal DDR (FCC)
31026	NRO upgrade kit
31030	Rack mount
2685	
31014	Mux upgrade kit (4-channel)
31016	Mux upgrade kit (6-channel)
31020	Internal DDR (FCC)
31030	Rack mount

Chapter 2
Control Panel Features and Trees

Contents

General 2-1
Control Panel Description 2-2
Rear Panel Description 2-5
Powering Up 2-6
Control Panel Trees 2-7
  Numerical Data Entry 2-7
  Error Messages 2-9
Status Tree 2-10
  GENERAL✳ Category 2-11
  DIAGNOS✳ Category 2-12
  CQMS✳ Category 2-13
  PRT SEL✳ Category 2-15
Test Tree 2-16
  LOOPBCK✳ Category 2-17
  CLR TST✳ Category 2-18
  POLL✳ Category 2-19
  BER✳ Category 2-20
  SELF✳ Category 2-21
  POL RES✳/BER RES✳/SLF RES✳ Category 2-22
Configuration Tree 2-23
  MODEM✳ Category 2-25
  Line Quality Feature 2-32A
  MUX 1✳ and MUX 2✳ Categories 2-33
  PORT n✳ Category 2-35
  NWK CTL✳ Category 2-39
Remote Tree 2-42
  Remote Operation 2-43
  Serial Number/Remote Control Addressing 2-43
  CONNECT✳ Category 2-44
  ASSIGN✳ Category 2-45
  SEARCH✳ Category 2-46
  MISC✳ Category 2-46
  MESSAGE✳ Category 2-46
Configuring the 2600 Series Modem 2-49
  Modem Configuration Worksheet 2-50
  Port Configuration Worksheet 2-52
  Network Configuration Worksheet 2-53
  DDR Option Configuration Worksheet 2-54

GENERAL

This chapter describes the front and rear panels of the 2600 Series Modem, explains the power-up sequence, and gives all the displays for the Status, Test, Configuration and Remote Trees that are used to configure and operate 2600 Series Modems. At the end of the chapter are worksheets for you to complete and use as a quick reference for the specific configurations you have selected.

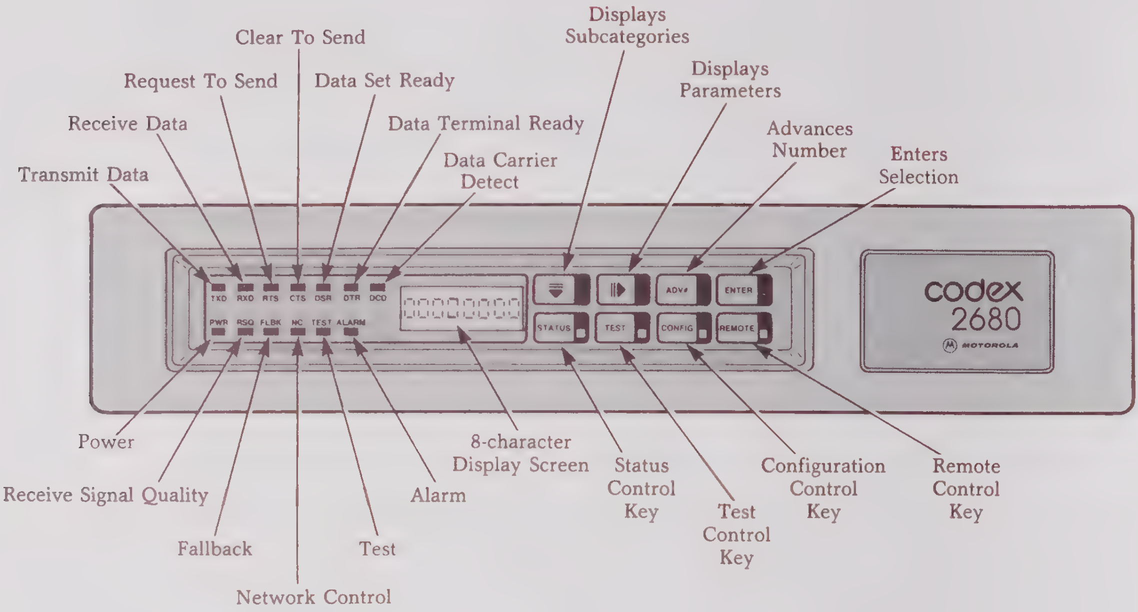

Clear To Send
Displays Subcategories
Request To Send
Data Set Ready
Displays Parameters
Receive Data
Data Terminal Ready
Advances Number
Data Carrier Detect
Enters Selection
Transmit Data
TXD
RXD
RTS
CTS
DSR
DTR
DCD
PWR
RSQ
FLBK
NC
TEST
ALARM
ADV#
ENTER
STATUS
TEST
CONFIG
REMOTE
codex
2680
MOTOROLA
Power
8-character Display Screen
Status Control Key
Configuration Control Key
Remote Control Key
Receive Signal Quality
Alarm
Test Control Key
Fallback
Test
Network Control

Figure 2-1. 2600 Control Panel

CONTROL PANEL DESCRIPTION

The Control Panel contains 13 indicators to allow you to monitor modem operation, an 8-character alphanumeric display to show various statistics and to assist you in working through the Control Panel trees, three movement keys, a selection key, and four function keys (see Figure 2-1).

The top row of LEDs contains EIA status indicators; the bottom row of LEDs contains the general status indicators. Indicators are defined in Table 2-1, and the Control Panel keys are described in Table 2-2. The Control Panel function keys (STATUS, TEST, CONFIG, REMOTE) are equipped with LEDs, which illuminate to indicate operation within that functional area.

Table 2-1.
Control Panel Indicators

Control Panel Abbreviation	*Definition*	*Function*
TXD (Yellow)	Transmit Data	Indicates transmit input data activity. Off for a Mark; On for a Space.
RXD (Yellow)	Receive Data	Indicates receive output data activity. Off for a Mark; On for a Space.
RTS (Red)	Request To Send	Lights when the terminal connected to the selected port has raised Request To Send.
CTS (Red)	Clear To Send	Lights when the port is accepting data in response to RTS.
DSR (Red)	Data Set Ready	Lights when power is On and modem is not in digital loopback, audio loopback, or a data-interruptive test mode.
DTR (Red)	Data Terminal Ready	Lights when data terminal to which the modem is connected is ready to send or receive data.
DCD (Red)	Data Carrier Detect	Lights when the selected port's EIA DCD signal is on and valid receive data is being delivered to the DTE.
PWR (Green)	Power	Lights when ac power is applied to the unit and the power supply is operational.
RSQ (Green)	Receive Signal Quality	Lights during normal receiver operation with good signal quality, loss of carrier, or absence of polls. Flickers for marginal signal quality.
FLBK (Yellow)	Fallback Indicator	Lights when modem is operating at a fallback rate that is below the normal rate for the product or is operating in Dial Restoral.
NC (Green)	Network Control	Lights when modem is attached to Network Management System or a remote control panel.
TST (Red)	Test	Lights when modem is in a test mode except at the modem initiating a V.54 Loop 2 test.
ALARM (Red)	Alarm	Diagnostic indicator signaling power-up or online error detection. Enter the Diagnostic display of the Status Tree, note the diagnostic code, clear it, and try again.

■ **Note:** All EIA Status Indicators (TXD, RXD, RTS, CTS, DSR, DTR, DCD) relate to the specific port selected in the Status Tree.

Table 2-2.
Control Panel Keys

Control Panel Abbreviation	*Function*
STATUS	Used to enter the Status Trees and to move among Status categories.
TEST	Used to enter the Test Trees and to move among the Test categories.
CONFIG	Used to enter the Configuration Trees and to move among the Configuration categories.
REMOTE	Used to enter the Remote Trees and to move among the Remote categories. Also used to establish a connection with a remote unit (see the paragraph on Serial Number/Network Control Addressing in the Remote Tree section of this chapter).
▼	Used to move downward through the Control Panel trees within the functional area chosen by one of the four function keys (i.e., STATUS, TEST, CONFIG, or REMOTE).
‖▶	Used to move sideways through the Control Panel Trees.
ADV #	Used to advance the flashing digit in a numerical display. For example, if entering a serial number, each successive depression of this key will increment the flashing number by 1, from 0 to 9.
ENTER	Used to select a parameter. Once selected, the parameter will flash on the display. *This is the only key that can cause a configuration change.*

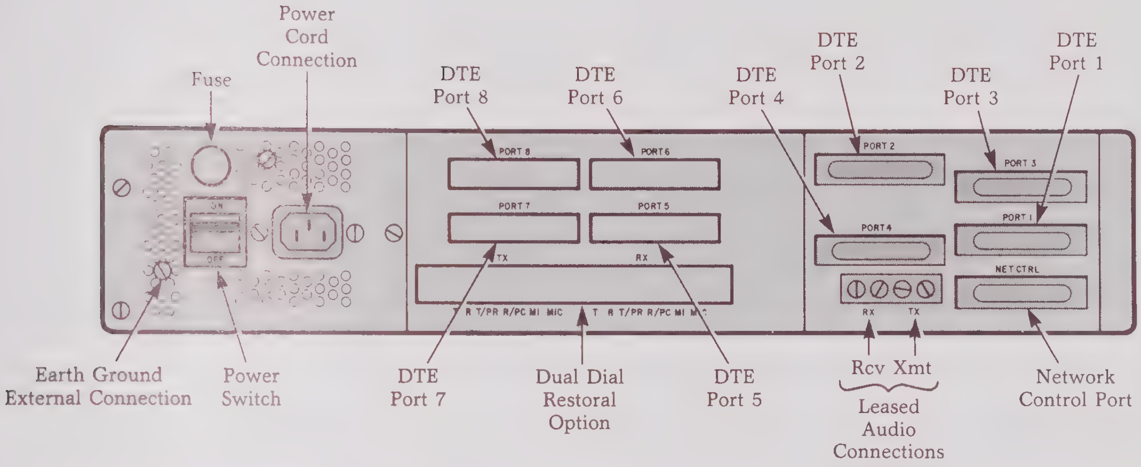

Power
Cord
Connection
Fuse
DTE
Port 8
DTE
Port 6
DTE
Port 4
DTE
Port 2
DTE
Port 3
DTE
Port 1
PORT 8
PORT 6
PORT 2
PORT 3
ON
OFF
PORT 7
PORT 5
PORT 4
PORT 1
NET CTRL
TX
RX
T R T/PR R/PC MI MIC
T R T/PR R/PC MI MIC
RX
TX
Earth Ground
External Connection
Power
Switch
DTE
Port 7
Dual Dial
Restoral
Option
DTE
Port 5
Rcv Xmt
Leased
Audio
Connections
Network
Control Port

Figure 2-2. 2600 Rear Panel

REAR PANEL DESCRIPTION

The rear panel (see Figure 2-2) consists of the Power ON/OFF switch; a 25-pin connector (Port 1), which is the standard EIA 232-C (CCITT V.24) interface connector supplying input/output data, control status, and timing interface signals between the modem and the data terminal equipment; 4-screw terminal block for transmit and receive leased line audio connections; and all necessary connection pins for the Multiplexer and Dual Dial Restoral (DDR) Options, among others.

POWERING UP

Customer audits by Codex indicate that rough handling by the shipper causes most early failures. To power up the 2600 Series Modem, ensure that the modem is plugged into its AC power source and place the ON/OFF power switch located on the rear panel into the ON position. The modem immediately initiates self-contained power-up diagnostics. The Control Panel displays a TESTING message until the power-up diagnostics are finished (normally 4 to 5 seconds) or until an error condition is detected.

If an error condition is detected, the power-up sequence is suspended and a power-up diagnostic message is displayed (see Table 2-3). Pressing any key clears the diagnostic message, and the modem will continue its power-up sequence. If power-up is unattended, the modem displays the diagnostic message for 45 seconds and then continues the power-up sequence. In either case, the rest of the power-up sequence may not succeed, due to the presence of an error condition. In that event, the modem reboots and starts the power-up sequence again. If the power-up sequence was able to continue to completion after detection of an error, you will know that an error was detected by the illumination of the ALARM LED. You may then enter the DIAGNOS✳ Category of the Status Tree to ascertain the nature of the error and to clear the ALARM LED (see DIAGNOS✳ Category in the Status Tree section of this chapter).

Online error conditions are those that may occur after the power-up sequence has been completed. When an online error condition is detected, the modem saves a diagnostic code in memory and then automatically reboots and reinitiates the power-up sequence. After this power-up sequence has been completed, the ALARM LED will come on, and you may go into the DIAGNOS✳ Category of the Status Tree to check the nature of the error and clear the ALARM LED (again, see DIAGNOS✳ Category in the Status Tree section of this chapter).

A power-up or online diagnostic message may be caused by a transient phenomenon such as a glitch on the power line and does not necessarily indicate a failure within the modem. The diagnostic messages help isolate the specific cause of a repeating error condition. The ALARM LED will go on at the detection of a power-up or online error and will stay on (even though the error condition may have gone away) until you clear it by entering the DIAGNOS✳ Category. If the ALARM LED has come on, enter the DIAGNOS✳ Category, note the diagnostic code, clear the ALARM LED, and try again. If you again receive the ALARM condition or the modem was unable to complete power-up diagnostics, turn the power off, reseat the PC cards, and try again.

The card codes found in the DIAGNOS✳ Category of the Status Tree identify the card that is suspected of causing the error condition (for example, DTE, Data Pump, and so on). The diagnostic messages displayed during power-up or shown in this DIAGNOS✳ Category are useful primarily to trained personnel for isolating the *specific* nature of a problem.

Table 2-3.
Power-Up Diagnostic Messages

Message	*Definition*
TESTING	No failure
DP_PM_F	Data Pump PROM checksum error
DTE_PM_F	DTE PROM checksum error
XL1_PM_F	XL1 PROM checksum error
DDR_PM_F	DDR PROM checksum error
DP_RM_F	Data Pump RAM test error
DTE_RM_F	DTE RAM test error
XL1_RM_F	XL1 RAM test error
DDR_RM_	DDR RAM test error
SER_NUM_F	Serial number error
E2_WRT_F	Nonvolatile memory write error
E2_CFM_F	Nonvolatile configuration memory checksum error
INIT E2	Will appear when reinitializing nonvolatile configuration memory after an "E2 CFM_F" error condition
E2_GEN_F	Nonvolatile memory general checksum error
DP_PIT_F	Data Pump PIT chip error
IPC_PM_F	IPC program memory failure
IPC_RM_F	IPC RAM failure

CONTROL PANEL TREES

Control Panel functional areas (Status, Test, Configuration, and Remote) consist of categories, subcategories, and parameters. A tree format in each of the functional areas allows the operator to easily move through the various branches to reach the desired selection. The eight soft-touch switches located on the Control Panel are used to step through these trees (see Figure 2-3). The Control Panel performs all the operations typically done by thumb-wheels, rotary switches, straps, and DIP switches inside a modem.

A category displayed on the Control Panel is followed by an asterisk (✳), for example, MODEM✳.

A subcategory is followed by a colon (:), for example, OP MODE:.

No special characters follow a parameter. When flashing, the parameter shown is the current selection. For example, when scrolling through the operating modes of the configuration functional area, if "PP TCM" is flashing, the modem is currently operating in the Point-to-Point Trellis-Coded Modulation mode.

Diagrams and explanations of the selections available on these trees are contained in the following sections.

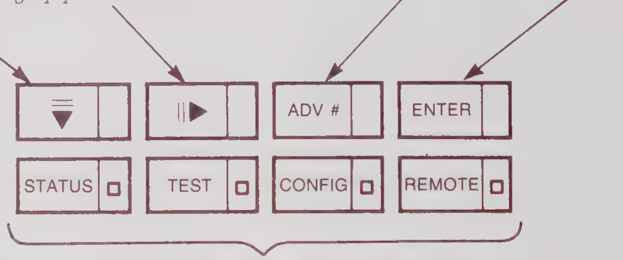
Three functional areas are password-protected: Test, Configuration, and Remote. The first time you wish to access these areas, you must enter a password. You can enter the Status Tree at any time without having to input a password. The password for 2600 Series modems is 5215. When the password is required, the display will prompt you with "ENTR PSW:". To enter the password, follow the example outlined in the Numerical Data Entry section which follows. ■ **Note:** You can disable the password protection by using the MISC✳ Category of the Remote Tree (see the MISC✳ Category section).

If no data is entered for 10 minutes, the display will revert to the current operating mode (for example, "PP TCM"), and you will have to enter the password again to access the restricted trees. This "timeout" function can be disabled by a selection located in the MISC✳ Category of the Remote Tree. In addition, when a session at the Control Panel is completed, you can "log out" by selecting the LOGOUT choice in the MISC✳ Category of the Remote Tree. Once you have logged out, you must enter the password again to access the restricted areas.

Numerical Data Entry

When you need to enter numerical data, you will find the previously selected value displayed with the leftmost digit flashing. The flashing is used as a cursor and signifies that the digit can be changed. Use the ADV # key to move through the allowable values. When you press the ‖▶ key, the next digit position on the right will flash. If the flashing digit is the one on the extreme right, pressing the ‖▶ key will return the display to the subcategory prompt (for example, "STRP 01:", "STRP 02:", and so on). Instructions on how to enter the password are provided here as an example of numerical data entry. When the display prompts with "ENTR PSW:", perform the following steps:

1) Press the ‖▶ key. The display will read: "0000", with the leftmost digit flashing.
2) Press the ADV # key five times. The display will read: "5000".
3) Press the ‖▶ key to move to the next digit on the right.
4) Press the ADV # key twice. The display will read: "5200".
5) Press the ‖▶ key to move to the next digit on the right.
6) Press the ADV # key once. The display will read: "5210".
7) Press the ‖▶ key to move to the next digit on the right.
8) Press the ADV # key five times. The display will read: "5215".
9) Press the ENTER key to enter the password. The display responds with "WELCOME". You now have access to all Control Panel trees. To enter numerical data, you must press the ENTER key. The display will then begin flashing, signifying that the data has been entered. If you do not press the ENTER key after you have entered a selection of numerical data, the values will not be set for the modem. When you press the ▼ key, the display will respond with: "ENTER?" At that time, you may enter the data or move to your next selection. ■ **Note:** If, because of some error, numerical data to be displayed has exceeded its bounds (for example, three digits coming up for a Remote Control address that is made up of only two digits), the display will fill with all asterisks (✳) rather than show the wrong data.


STATUS
TEST
CONFIG
REMOTE
ADV #
ENTER

The downward-pointing key leads you through the subcategories of the functional area you have selected.

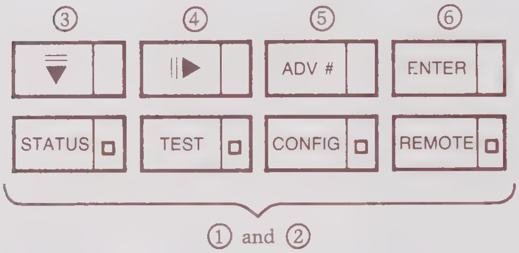
The rightward-pointing key leads you through the series of parameters within the subcategory you have chosen.

Advances the number when you are setting numerical data.

Enters the selections you have made.

Used to enter the four functional areas and to move among the categories.

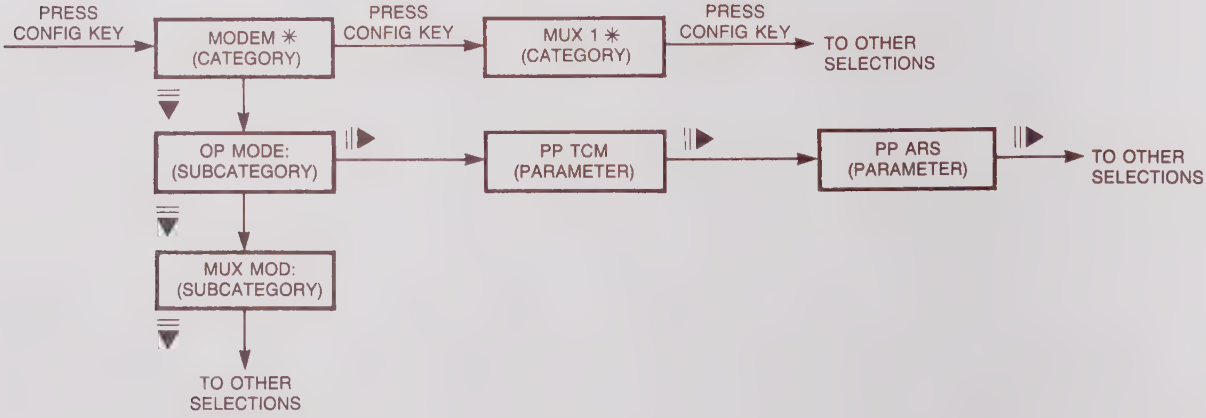
(A) Controls


③
④
⑤
⑥
ADV #
ENTER
STATUS
TEST
CONFIG
REMOTE
① and ②

This figure shows the typical sequence of using the Control Panel:

① Choose the functional area.
② Choose the category.
③ Move downward through the subcategories.
④ Move horizontally through the parameters.
⑤ If applicable, change the numerical value.
⑥ Enter the selections you have made.

(B) Typical Control Panel Sequence


PRESS CONFIG KEY
MODEM ✳ (CATEGORY)
PRESS CONFIG KEY
MUX 1 ✳ (CATEGORY)
PRESS CONFIG KEY
TO OTHER SELECTIONS
OP MODE: (SUBCATEGORY)
PP TCM (PARAMETER)
PP ARS (PARAMETER)
TO OTHER SELECTIONS
MUX MOD: (SUBCATEGORY)
TO OTHER SELECTIONS

(C) Sample Control Panel Tree

Figure 2-3. Control Panel Trees and Controls

Error Messages

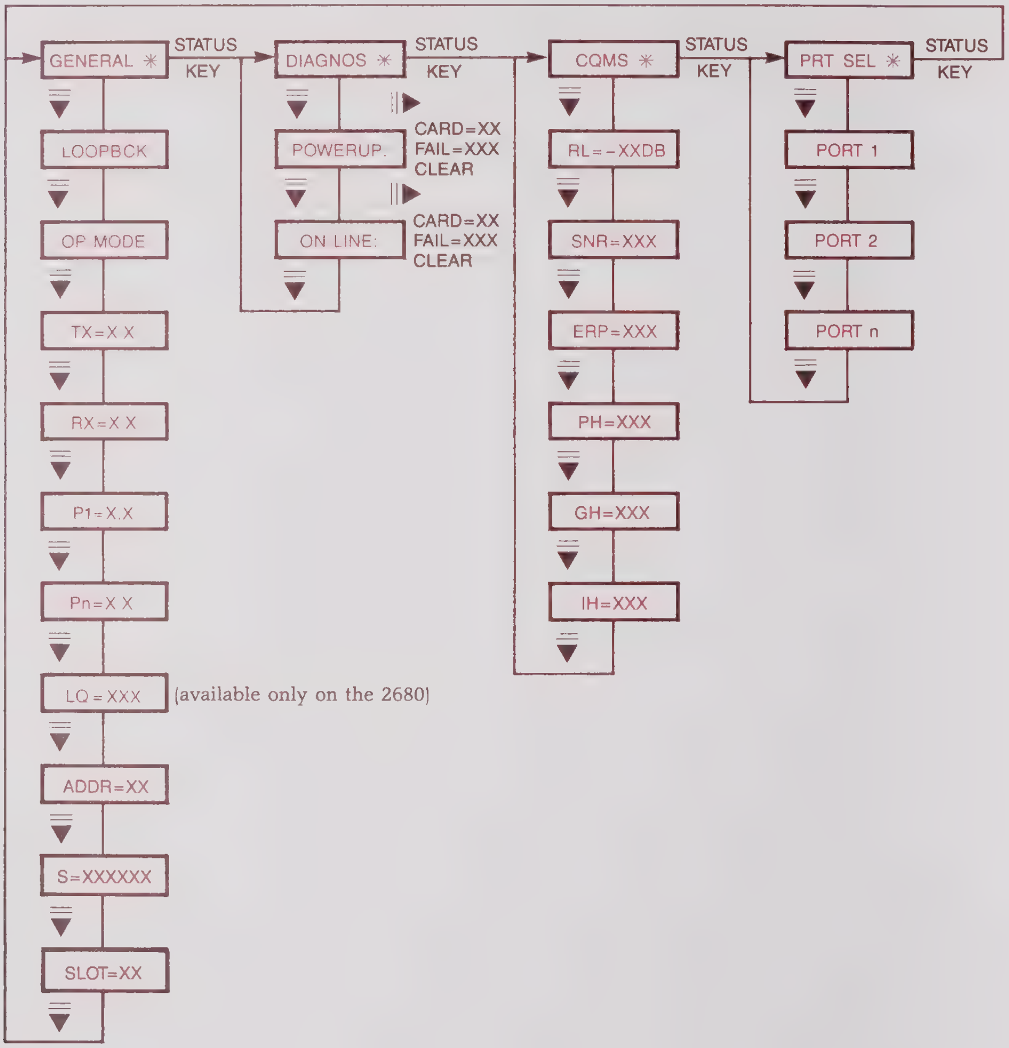
Control Panel error messages are listed and defined in Table 2-4. These messages represent operator input errors and communication line faults and do not reflect a failure within the modem. Errors 20, 30, and 40 are remote Control Panel communication errors.

Table 2-4.
Control Panel Error Messages

Error Message	*Definition*	*Recommended Action*
■ **Note:** These messages represent operator input errors and communications line faults and do not reflect a failure within the modem.		
ERROR 20	No response received from remote modem.	Verify network control address. If correct, run diagnostic test to check communications line to remote modem. (With the DDR Option, try again after a 3-minute wait. If same error occurs, terminate using "W/O TST" selection.)
ERROR 25	No response received from nest modem. Now connected to Modem 1.	Reseat modem cards, reconnect to desired modem, and try again.
ERROR 30	Remote response has an invalid checksum.	You most likely have a problem with your communications line. Check configuration (such as FSK rate compatibility), and run diagnostics on communications line to remote modem. (With DDR Option, try again after a 3-minute wait. If same error occurs, terminate using "W/O TST" selection.)
ERROR 40	Invalid response received or remote modem is in Override.	Check that remote modem is not in Override (see MISC✳ Category section in this chapter) and that option compatibility exists between local and remote modems. Try again.
ERROR 50	Already on dial line.	No action necessary.
ERROR 52	Already on leased line.	No action necessary.
ERROR 54	No response received from remote modem.	Wait three minutes for remote modem to switch to dial line.
ERROR 56	No response received from remote modem.	Check to see if passing data on dial line. If not, terminate using "W/O TST" selection.
ERROR 60	Operation not currently allowed because modem is controlled by a remote source (network control or a remote modem).	Check with Network Management Systems for permission to enter manual override (see MISC✳ Category section in this chapter).
ERROR 65	Channel compatibility does not exist between local and remote modems.	Check to ensure remote modem is a muxed modem.
ERROR 70	Illegal assignment of ports to channels.	Enter proper port-to-channel configuration.
ERROR 75	Overextension of bandwidth. Port channel rates exceed main channel rate.	Check MUX 1✳ or MUX 2✳ configuration to ensure that the sum of port speeds does not exceed main channel rate.
ERROR 80	Undefined configuration memory data or not valid to configure this parameter in this application.	Scroll to proper selection and press ENTER to correct configuration data (see appropriate category in the Configuration Tree section of this chapter).

STATUS TREE

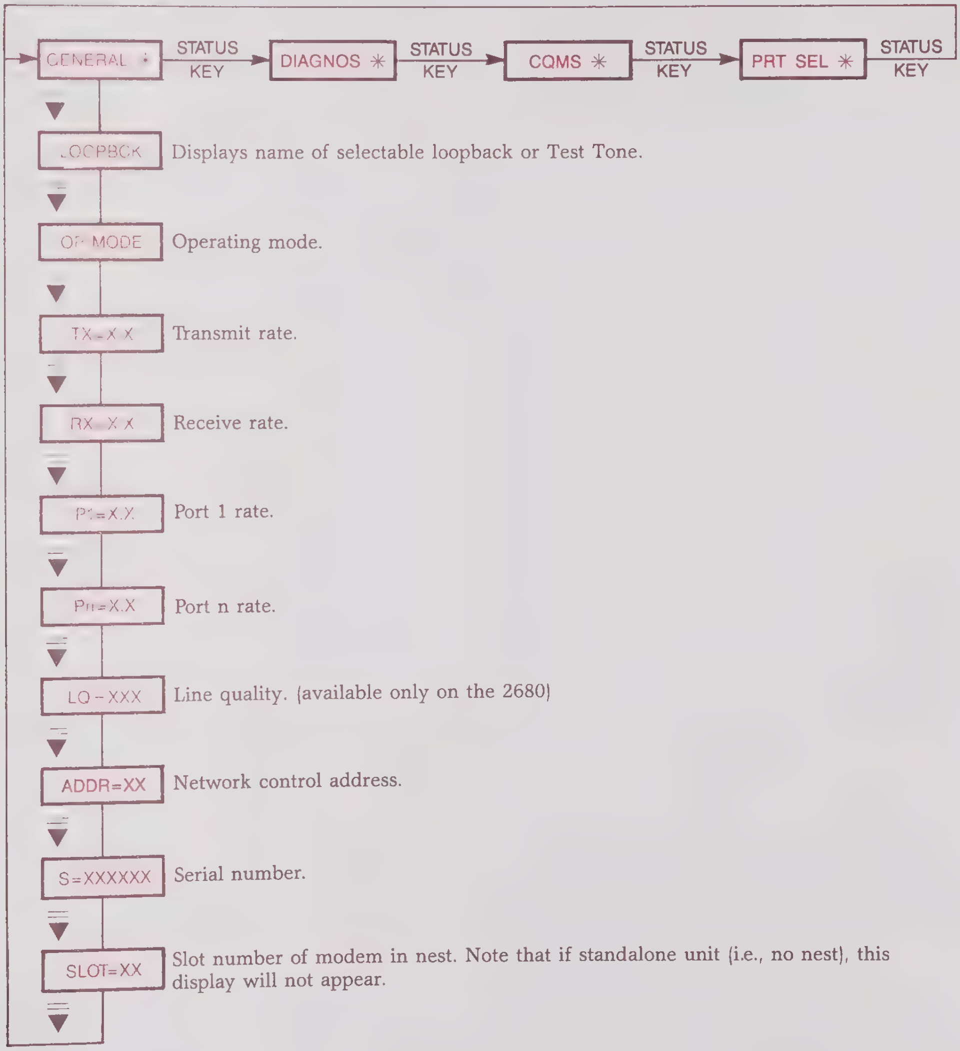
The STATUS functional area allows you to examine operating, diagnostics, port, and CQMS status.


GENERAL ✳
STATUS KEY
DIAGNOS ✳
STATUS KEY
CQMS ✳
STATUS KEY
PRT SEL ✳
STATUS KEY
LOOPBCK
OP MODE
TX=X X
RX=X X
P1=X.X
Pn=X X
LQ=XXX
ADDR=XX
S=XXXXXX
SLOT=XX
POWERUP:
CARD=XX
FAIL=XXX
CLEAR
ON LINE:
CARD=XX
FAIL=XXX
CLEAR
RL=–XXDB
SNR=XXX
ERP=XXX
PH=XXX
GH=XXX
IH=XXX
PORT 1
PORT 2
PORT n

(available only on the 2680)

GENERAL✳ Category

The GENERAL Category displays various operating parameters and identification information (for example, serial number, network control address).


GENERAL ✳
STATUS KEY
DIAGNOS ✳
STATUS KEY
CQMS ✳
STATUS KEY
PRT SEL ✳
STATUS KEY
LOOPBCK
OP MODE
TX=X.X
RX=X.X
P1=X.X
Pn=X.X
LQ-XXX
ADDR=XX
S=XXXXXX
SLOT=XX

Displays name of selectable loopback or Test Tone.

Operating mode.

Transmit rate.

Receive rate.

Port 1 rate.

Port n rate.

Line quality. (available only on the 2680)

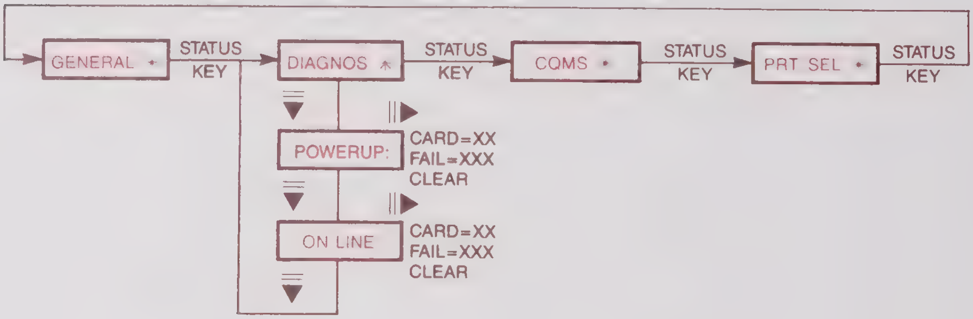
Network control address.

Serial number.

Slot number of modem in nest. Note that if standalone unit (i.e., no nest), this display will not appear.

DIAGNOS✳ Category

The DIAGNOStics Category displays results from power-up and online diagnostics. Power-up diagnostic status information is stored in RAM and represents the results from the most recent power-up. Online diagnostic status information is stored in nonvoltatile memory and will be retained even after a power loss. When you observe and acknowledge either ALARM condition, you can clear it from either memory as shown below. Only one failure code of each type (that is, power-up, online) can be stored; if there has been more than one failure, the first failure to be detected will be stored in memory.


GENERAL *
STATUS KEY
DIAGNOS *
STATUS KEY
COMS *
STATUS KEY
PRT SEL *
STATUS KEY
POWERUP:
CARD=XX
FAIL=XXX
CLEAR
ON LINE
CARD=XX
FAIL=XXX
CLEAR

The following displays are shown under the DIAGNOS✳ Category:

- **CARD=XX.** This is the address of the problem card. See Table 2-5 for card identification number.
- **FAIL=XXX.** The failure code for Codex use only.
- **CLEAR.** Enables you to clear the failure code from memory. Entering this command by pressing ENTER will result in a screen display of COMPLETE.

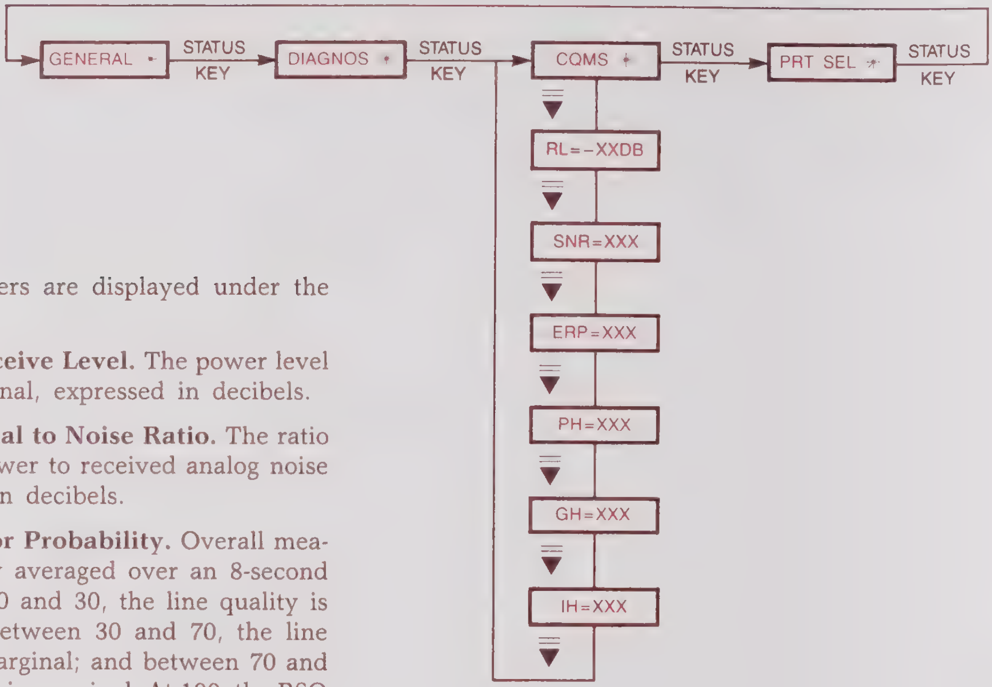
Table 2-5.
Diagnostic Codes

Card Code	*Failure Code*	*Suspected Area*	*Definition*
Power-Up			
00	000	—	No failure
01	001	Data Pump Card	Data Pump PROM checksum error
02	001	DTE Card	DTE PROM checksum error
03	001	XL1 Card	XL1 PROM checksum error
04	001	DDR Card	DDR PROM checksum error
01	002	Data Pump Card	Data Pump RAM test error
02	002	DTE Card	DTE RAM test error
03	002	XL1 Card	XL1 RAM test error
04	002	DDR Card	DDR RAM test error
05	003	I/O Panel	Serial Number error
02	006	DTE Card	E^2 write error
02	007	DTE Card	E^2 configuration memory checksum error
02	008	DTE Card	E^2 general checksum error
01	010	Data Pump Card	Data Pump PIT chip error
Online			
00	000	—	No failure
06	004	—	Queue overflow error
06	005	—	Timer overflow error
01	011	Data Pump Card	Main channel self-test error
02	012	DTE Card	FSK self-test error
02	013	DTE Card	DTE self-test error
02	014	DTE Card	FSK self-test error
01	015	Data Pump Card	SPE diagnostic error
01	016	Data Pump Card	SPE diagnostic error
07	022	Expansion Card	IPC failure

CQMS✳ Category

The CQMS (Circuit Quality Monitoring System) Category displays the selected parameters continuously monitored by the CQMS feature. While the display is present, it is constantly updated in both local and remote modems.

When certain CQMS parameters are not valid for a specific application or for loss of carrier, the data will be replaced with percentage (%) signs. At multipoint masters in normal operation, none of these parameters are valid, and, therefore, are displayed as percentage signs; however, during any constant carrier test, such as a BER Test, they are valid and can be displayed. For more information on CQMS, see Chapter 3 and Chapter 4 for point-to-point and multipoint applications, respectively.

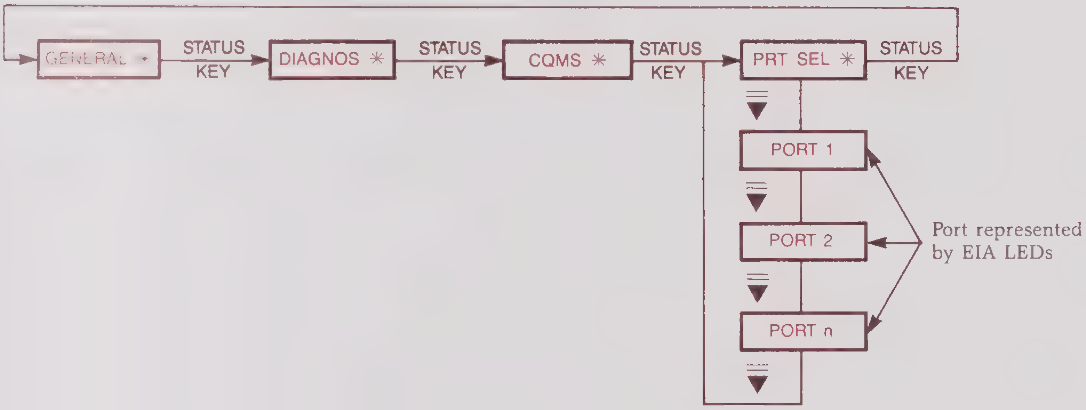


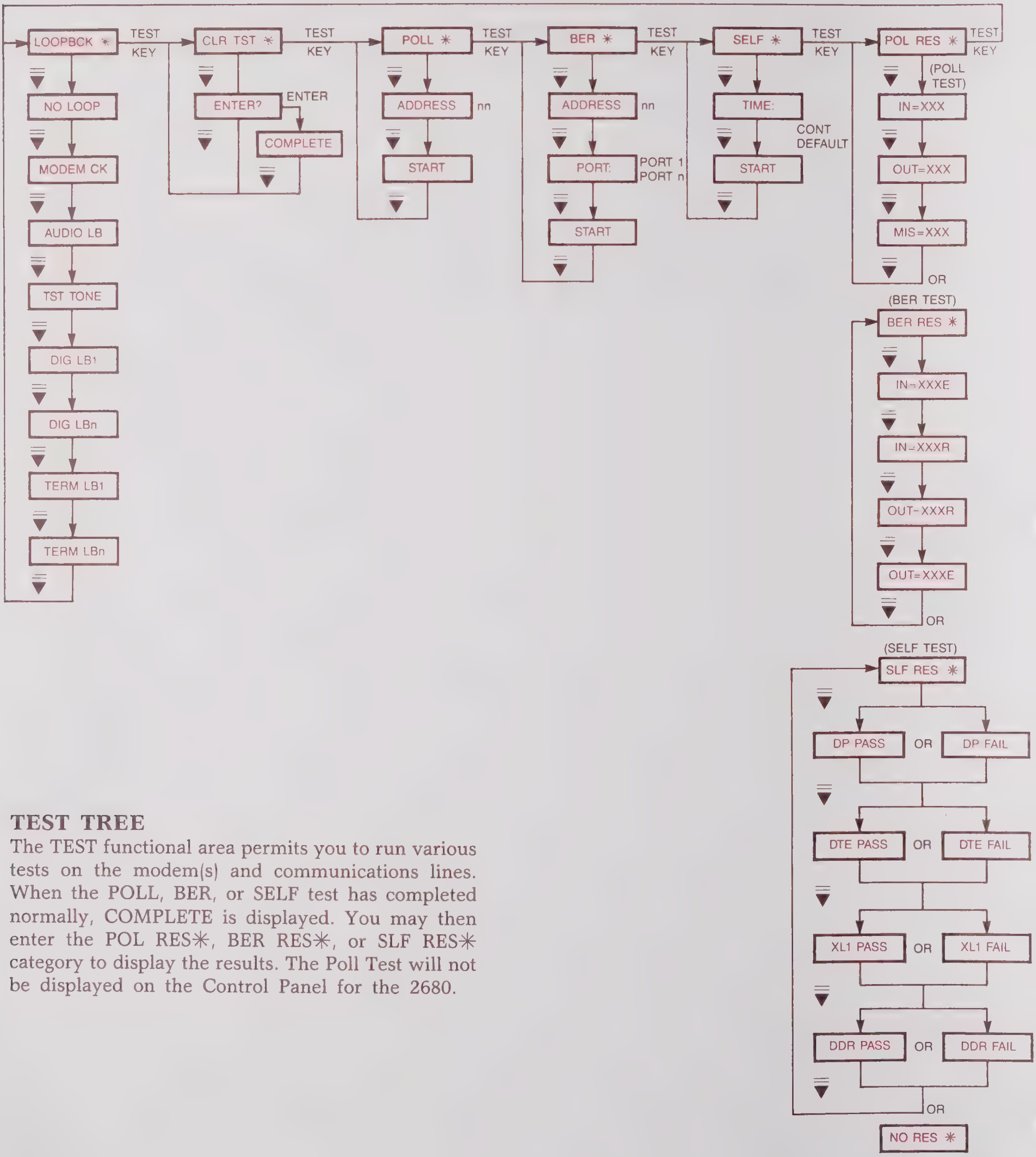
The following parameters are displayed under the CQMS✳ Category:

- **RL=-XXDB = Receive Level.** The power level of the received signal, expressed in decibels.
- **SNR=XXX = Signal to Noise Ratio.** The ratio of analog signal power to received analog noise power, expressed in decibels.
- **ERP=XXX = Error Probability.** Overall measure of line quality averaged over an 8-second window. Between 0 and 30, the line quality is considered good; between 30 and 70, the line quality is fair to marginal; and between 70 and 100, the line quality is marginal. At 100, the RSQ LED will turn off.
- **PH=XXX = Phase Hits.** The number of phase hits in a 15-minute interval and updated every 5 minutes. A phase hit is a sudden change in phase within the modem carrier recovery loop, often caused by switching or routing changes within the network as well as by other disturbances that get coupled into the carrier.
- **GH=XXX = Gain Hits.** The number of gain hits in a 15-minute interval and updated every 5 minutes. A gain hit is a sudden change in gain within the modem, often caused by switching or routing changes within the network as well as by other disturbances that get coupled into the carrier.
- **IH=XXX = Impulse Hits.** The number of impulse hits in a 15-minute interval and updated every 5 minutes. An impulse hit is a short and sudden change in the noise level of a channel, generally affecting both the amplitude and phase of a received signal. Most impulse hits are sporadic in nature and are the result of miscellaneous power switching (unrelated to the modem), which radiates into the system network.

PRT SEL✳ Category

The PoRT SELect Category allows you to select the port to be represented by the EIA LEDs. You must hit the ENTER key when the desired port number is displayed. The display will flash to confirm that the port is the one currently being monitored. This category will not be displayed if the modem is in the remote mode.


GENERAL ✳
STATUS KEY
DIAGNOS ✳
STATUS KEY
CQMS ✳
STATUS KEY
PRT SEL ✳
STATUS KEY
PORT 1
PORT 2
PORT n
Port represented by EIA LEDs

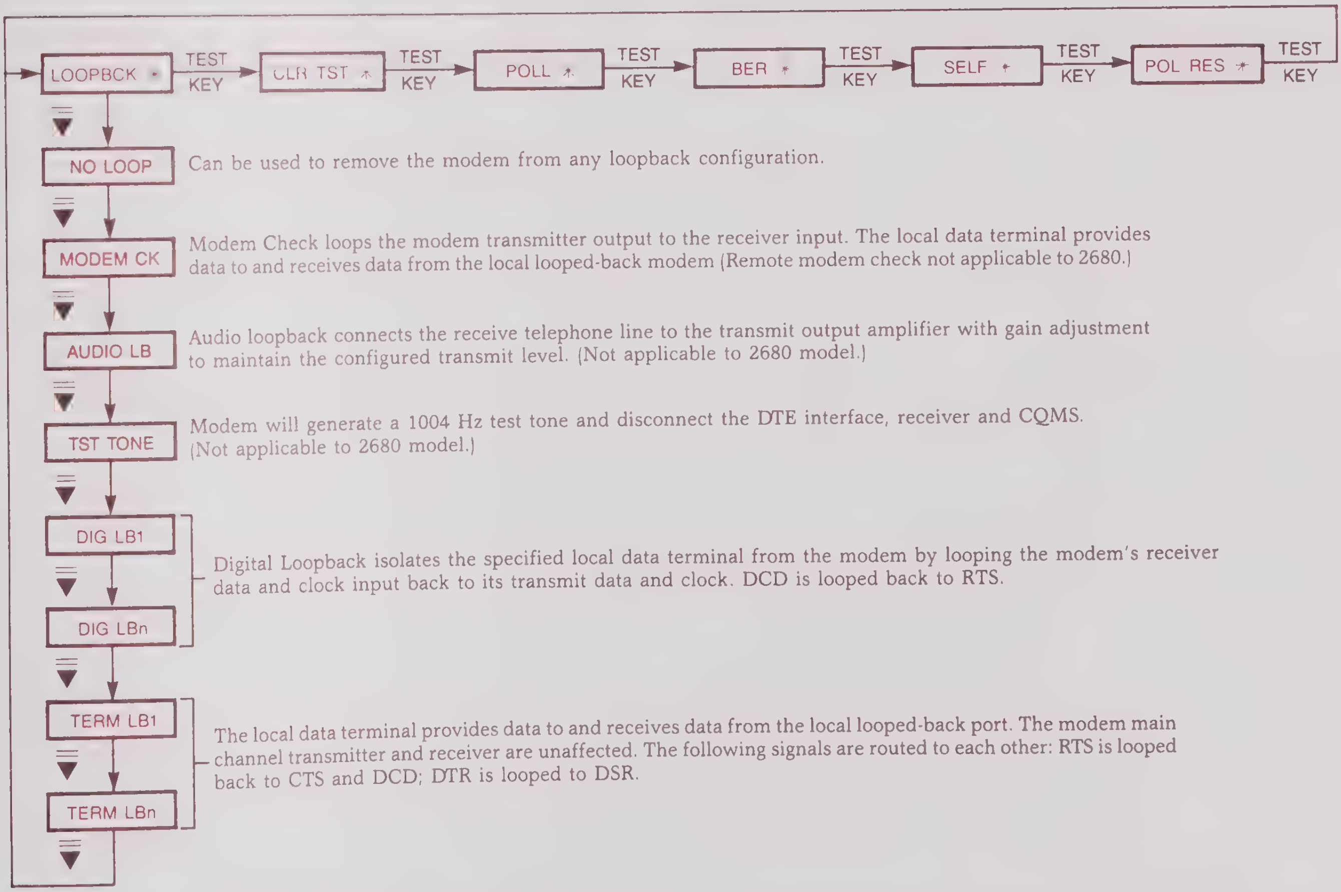

LOOPBCK ✳
TEST KEY
NO LOOP
MODEM CK
AUDIO LB
TST TONE
DIG LB1
DIG LBn
TERM LB1
TERM LBn
CLR TST ✳
TEST KEY
ENTER?
ENTER
COMPLETE
POLL ✳
TEST KEY
ADDRESS
nn
START
BER ✳
TEST KEY
ADDRESS
nn
PORT:
PORT 1
PORT n
START
SELF ✳
TEST KEY
TIME:
CONT
DEFAULT
START
POL RES ✳
TEST KEY
(POLL TEST)
IN=XXX
OUT=XXX
MIS=XXX
OR
(BER TEST)
BER RES ✳
IN=XXXE
IN=XXXR
OUT=XXXR
OUT=XXXE
OR
(SELF TEST)
SLF RES ✳
DP PASS
OR
DP FAIL
DTE PASS
OR
DTE FAIL
XL1 PASS
OR
XL1 FAIL
DDR PASS
OR
DDR FAIL
OR
NO RES ✳

TEST TREE

The TEST functional area permits you to run various tests on the modem(s) and communications lines. When the POLL, BER, or SELF test has completed normally, COMPLETE is displayed. You may then enter the POL RES✳, BER RES✳, or SLF RES✳ category to display the results. The Poll Test will not be displayed on the Control Panel for the 2680.

LOOPBCK✳ Category

The LOOPBaCK Category allows you to initiate modem check, audio loopback, test tone, digital loopback, and terminal loopback. Only one loopback can be in effect at any given time. The selection of a new loopback cancels any previous selection. The "NO LOOP" selection can be used to remove the modem from any loopback configuration. See the Loopbacks and Tests section in Chapter 1 for general information. See Chapters 3 and 4 for detailed information on point-to-point and multipoint loopback and test features.



NO LOOP: Can be used to remove the modem from any loopback configuration.

MODEM CK: Modem Check loops the modem transmitter output to the receiver input. The local data terminal provides data to and receives data from the local looped-back modem (Remote modem check not applicable to 2680.)

AUDIO LB: Audio loopback connects the receive telephone line to the transmit output amplifier with gain adjustment to maintain the configured transmit level. (Not applicable to 2680 model.)

TST TONE: Modem will generate a 1004 Hz test tone and disconnect the DTE interface, receiver and CQMS. (Not applicable to 2680 model.)

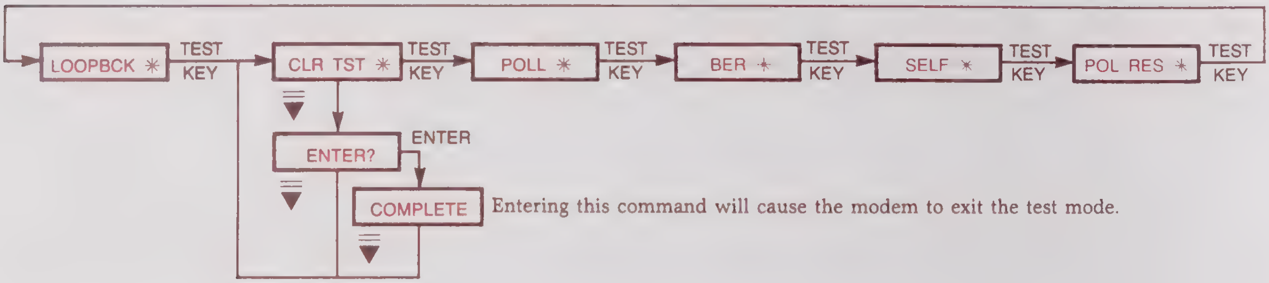
DIG LB1 – DIG LBn: Digital Loopback isolates the specified local data terminal from the modem by looping the modem's receiver data and clock input back to its transmit data and clock. DCD is looped back to RTS.

TERM LB1 – TERM LBn: The local data terminal provides data to and receives data from the local looped-back port. The modem main channel transmitter and receiver are unaffected. The following signals are routed to each other: RTS is looped back to CTS and DCD; DTR is looped to DSR.

■**Note:** The PP ARS modem will fall back when run through an audio loopback or when it receives a test tone (either modem-generated or externally-generated). If you plan to run PP ARS with audio loopbacks, test tones, or any other artificially degraded line, you should first set the "Equalization Recovery Disable" strap to lock the Adaptive Rate System at the current rate. If you do not do this, the adaptive rate will react to the degraded condition and fall back very quickly. When the line condition returns to normal, it will fall forward normally but will take considerable time to return to 16.8 kbps. *Do not forget to reset this strap after testing to reenable the adaptive rate feature.*

CLR TST✳ Category

The CLeaR TeST Category allows you to clear a test in the event that the modem had been inadvertently left in a test mode (for example, if the master modem had powered down during a test, leaving the remote modem still in the test mode).


LOOPBCK ✳
TEST KEY
CLR TST ✳
TEST KEY
POLL ✳
TEST KEY
BER ✳
TEST KEY
SELF ✳
TEST KEY
POL RES ✳
TEST KEY
ENTER?
ENTER
COMPLETE

Entering this command will cause the modem to exit the test mode.

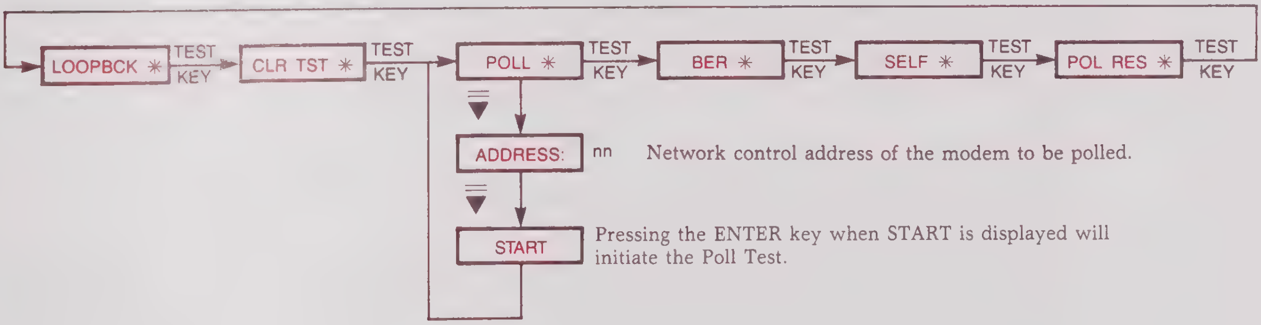
POLL✳ Category

The POLL Category allows you to initiate a Poll Test, which checks the polling performance of the main channel between a master modem and a slave modem on a line segment. During this test, the master modem sends 256 polls to the designated slave. The slave compares the received messages with those expected and keeps track of errors. The test message is then sent back to the master modem, which keeps count of errors in this inbound direction. Communications on the line are disrupted for the duration of this test.

To see the results of this test, you must enter the POL RES✳ Category after the Poll Test has been finished and the screen has displayed COMPLETE.
■ **Note:** The Poll Test is designed for use in multipoint applications and should not be used for point-to-point testing. Selecting the Poll Test in point-to-point applications at speeds greater than 9.6 kbps may cause the modem conducting the test to repeat its power-up sequence. Use the Bit Error Rate (BER) Test for all point-to-point testing.

Pressing the ENTER key when START is displayed will initiate the Poll Test. Once the ENTER key is pressed, the following will be displayed:

1) Display will show SETUP for approximately 3 seconds.
2) Display will show POLS=XXX and begin counting down. This is the number of polls remaining to be sent. Note that the test can be aborted only while POLS=XXX is being displayed. To abort, press the ENTER key again.
3) When all polls are completed, display will show CLEAR xx for approximately 6 seconds, where xx is a 2-second countdown repeated 3 times.
4) If the test is completed normally, COMPLETE is displayed; otherwise, ABORTED is displayed.
5) Enter the POL RES✳ Category of the Test Tree to display the results of this test.



Network control address of the modem to be polled.

Pressing the ENTER key when START is displayed will initiate the Poll Test.

BER✳ Category

The BER Category allows you to check the steady-state performance of the main channel of a line segment. This test is performed end-to-end and is primarily a point-to-point test, but it can be used in a multipoint application with one slave. A single specified device generates a test pattern to the master. The master sends a test pattern to the specified device, and both inbound and outbound errors are reported. The BER Test disrupts communications on the main channel for the duration of the test.

To see the results of this test, you must enter the BER RES✳ Category after the BER Test has been finished and the COMPLETE message has been displayed.

Once the ENTER key is pressed, the following will occur:

1) The display will show SETUP for approximately 3 seconds.

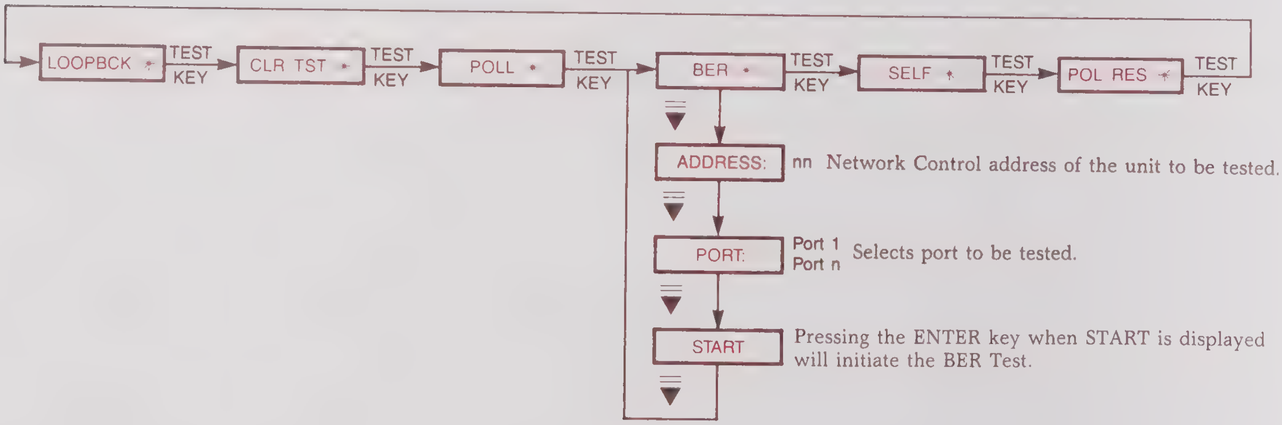
2) The display will show INIT xx, where xx is a 5-second countdown.

3) The display will shown BLKS=XXX and begin counting down. This is the number of 10,000-bit blocks remaining to be sent outbound. The test can be aborted only while BLKS=XXX is being displayed. To abort, press ENTER.

4) When all blocks have been sent, the display will show CLEAR xx for approximately 6 seconds, where xx is a 2-second countdown repeated 3 times.

5) If the test is completed normally, COMPLETE is displayed; otherwise, ABORTED is displayed.

6) Enter the BER RES✳ Category of the Test Tree to display the results of this test.



Network Control address of the unit to be tested.

Selects port to be tested.

Pressing the ENTER key when START is displayed will initiate the BER Test.

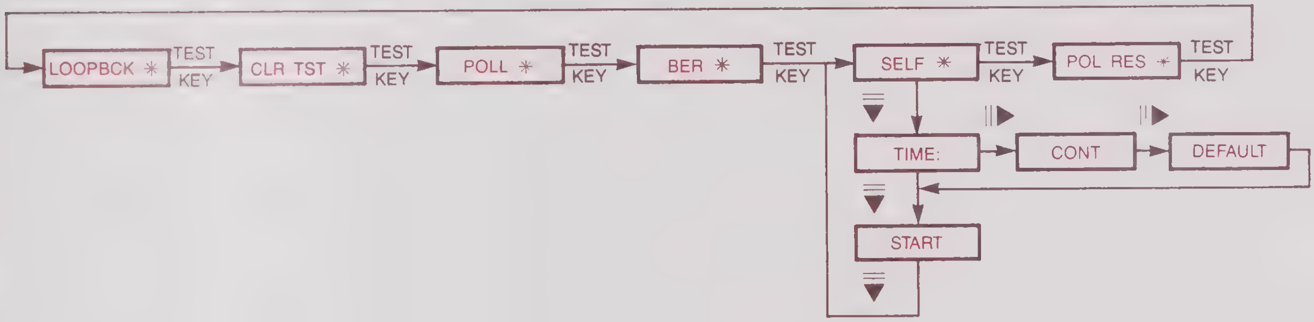
SELF✳ Category

The SELF Category allows you to initiate internal loopback diagnostics on the modem. The test will send and verify receipt of test patterns through the control channel.

The SELF Category allows you to initiate the loopback diagnostic on the modem as follows. Pressing the ENTER key when START is displayed will initiate the Self Test. (The test may be aborted at any time by again pressing the ENTER key.) While the test is running locally, TESTING is displayed. When the test is complete, PASSED or FAILED is displayed.

If FAILED is displayed, enter the SLF RES✳ Category of the Test Tree to display the results of this test. When running in CONT, after ABORT, go to the DIAGNOS✳ Category of the Status Tree to view results of the test (failure code), because the SLF RES✳ Category may not be accurate.

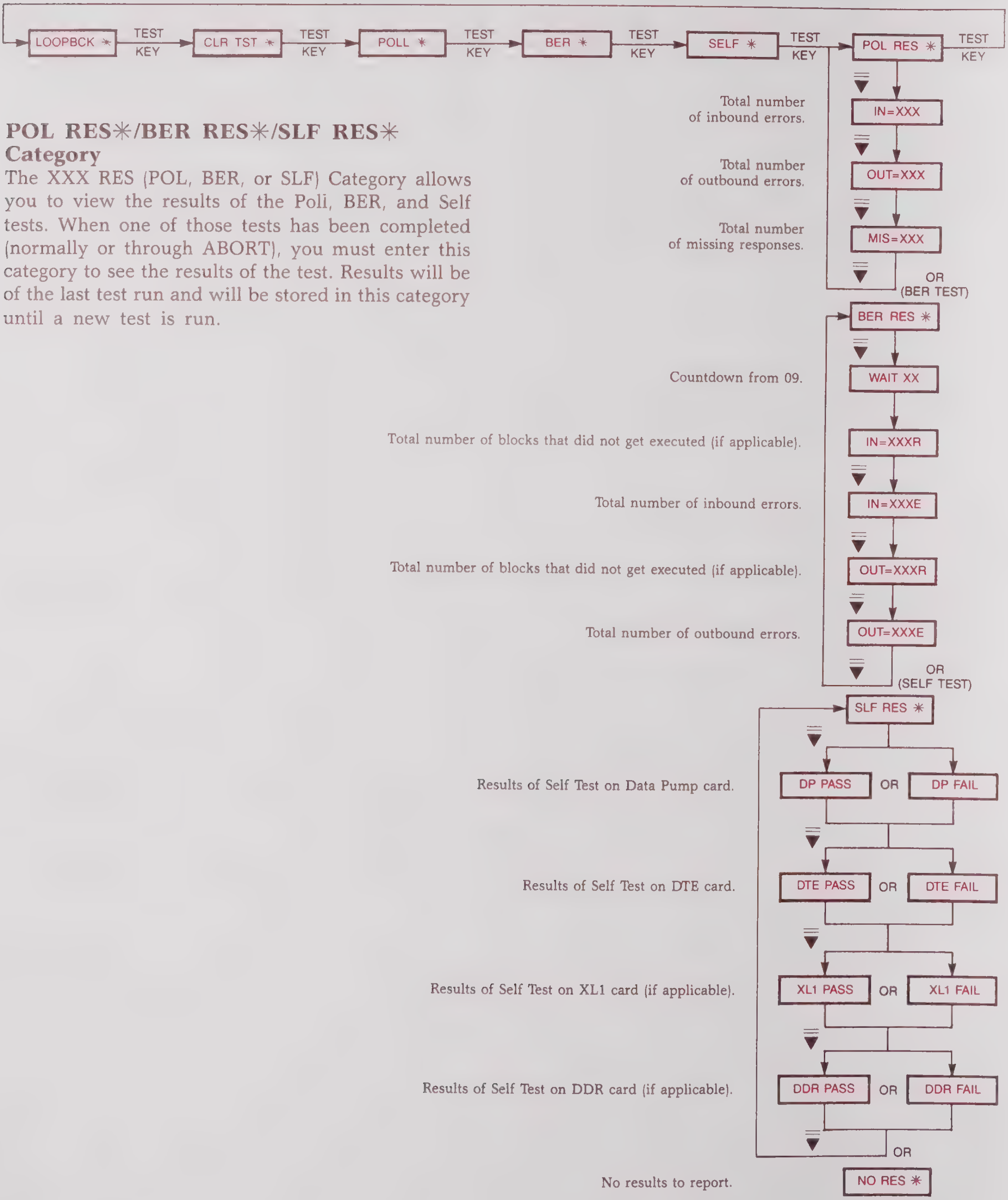
In remote operation, INIT xx will be displayed at the beginning of the test for approximately 15 seconds, where xx is a 5-second countdown repeated 3 times. The test then performs the same as in the local mode.



- **CONT.** Specifies that the test is to be run continuously until aborted. This selection is for local mode only.
- **DEFAULT.** Specifies that the test will be run once.

POL RES✳/BER RES✳/SLF RES✳ Category

The XXX RES (POL, BER, or SLF) Category allows you to view the results of the Poli, BER, and Self tests. When one of those tests has been completed (normally or through ABORT), you must enter this category to see the results of the test. Results will be of the last test run and will be stored in this category until a new test is run.


LOOPBCK ✳
TEST KEY
CLR TST ✳
TEST KEY
POLL ✳
TEST KEY
BER ✳
TEST KEY
SELF ✳
TEST KEY
POL RES ✳
TEST KEY
IN=XXX
OUT=XXX
MIS=XXX
OR (BER TEST)
BER RES ✳
WAIT XX
IN=XXXR
IN=XXXE
OUT=XXXR
OUT=XXXE
OR (SELF TEST)
SLF RES ✳
DP PASS
OR
DP FAIL
DTE PASS
OR
DTE FAIL
XL1 PASS
OR
XL1 FAIL
DDR PASS
OR
DDR FAIL
OR
NO RES ✳

Total number of inbound errors.

Total number of outbound errors.

Total number of missing responses.

Countdown from 09.

Total number of blocks that did not get executed (if applicable).

Total number of inbound errors.

Total number of blocks that did not get executed (if applicable).

Total number of outbound errors.

Results of Self Test on Data Pump card.

Results of Self Test on DTE card.

Results of Self Test on XL1 card (if applicable).

Results of Self Test on DDR card (if applicable).

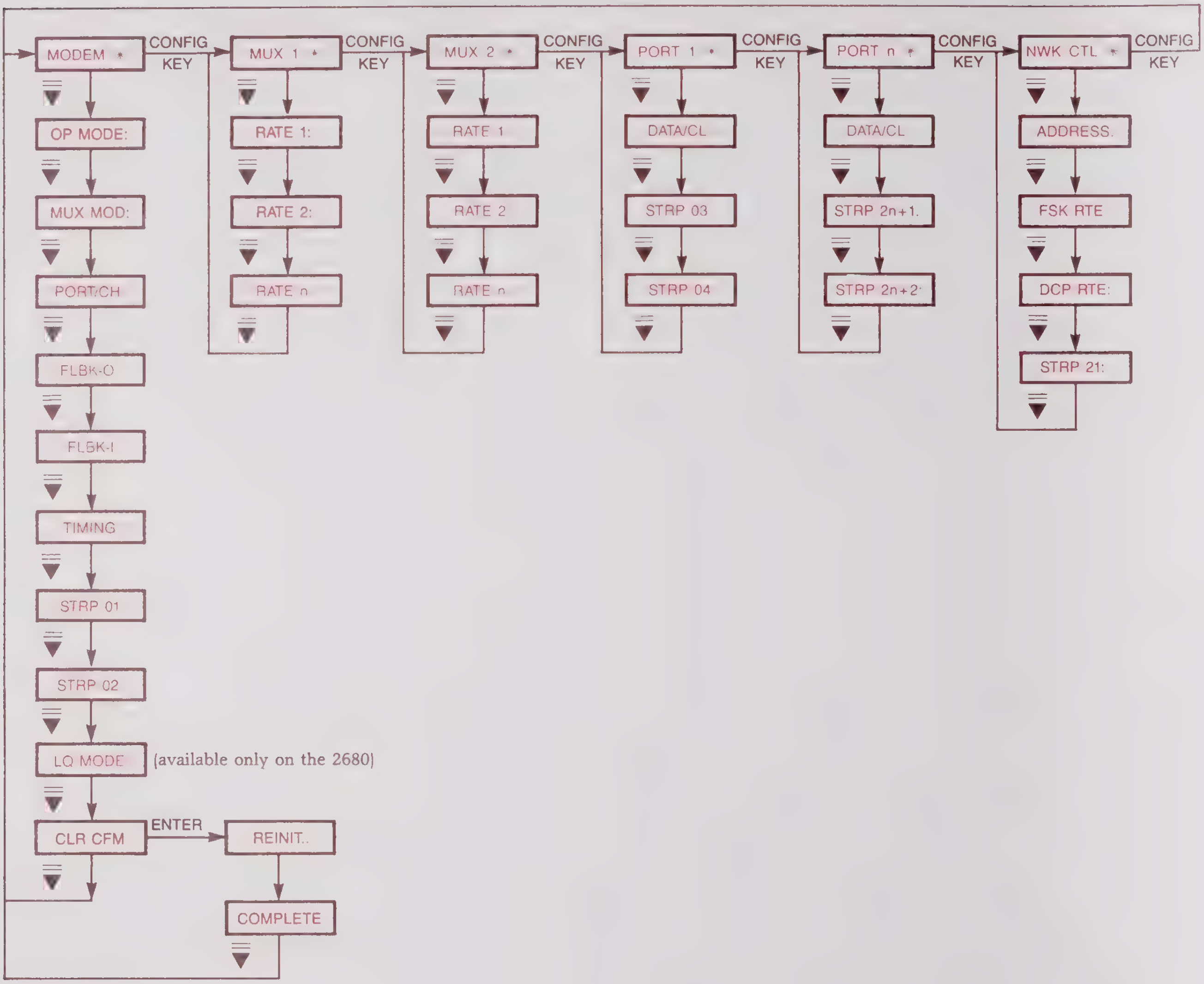
No results to report.

CONFIGURATION TREE

The CONFIGURATION functional area permits you to choose from a variety of menus to tailor the operation of the modem to the needs of your specific application.

Strapping from the Control Panel takes place as follows. A display of up to eight digits may relate to a maximum of eight different functional straps. For example, Modem Strap 2 of the Configuration Tree will display 8 digits: xxxxxxxx. The first digit enables/disables Round Robin, the second digit selects Round Robin blind time, the third digit selects UI error rate threshold, the fourth digit selects UI threshold time period, the fifth digit enables/disables Circuit 141, the sixth digit selects leased line carrier detect threshold level, the seventh digit selects CS48FP scramblers/descramblers, and the eighth digit is available for future programming by Codex. Each digit can take on a value of 1 or 0 (On or Off), and the choice of 1 or 0 makes the strap selection.

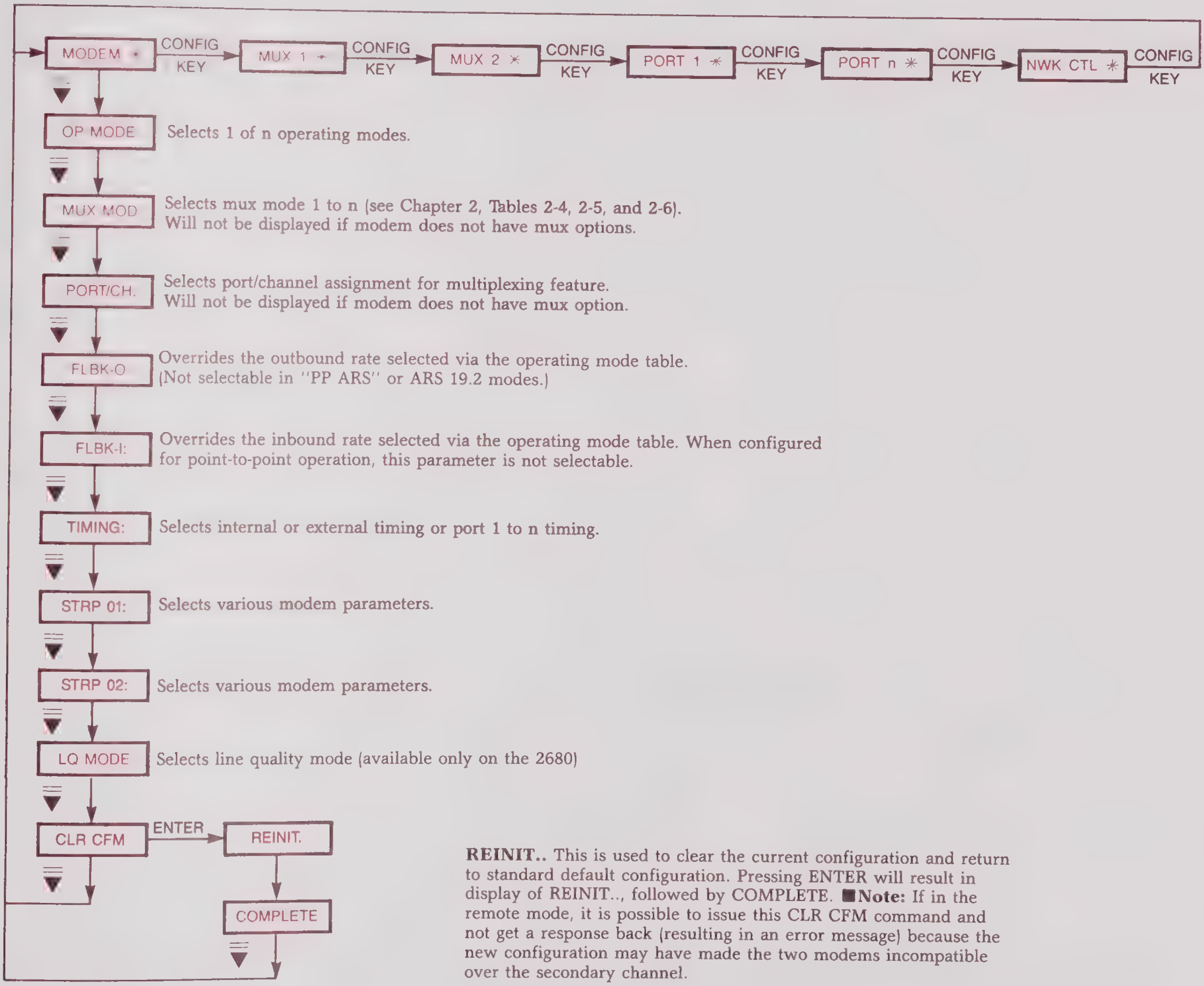
In most cases, each digit refers to one specific strap and is independent of all other digits displayed, as illustrated in the previous example. However, in some instances, a group of two to four digits may work in conjunction to give a value to a particular strap. For example, the second, third, fourth, and fifth digits of Modem Strap 1 of the Configuration Tree combine to set the leased line transmit level. That is, x0000xxx would set a transmit level of 0 dBm, x0001xxx would set a transmit level of −1 dBm, x0010xxx would set a transmit level of −2 dBm, and so on. The strap/digit designations are defined in their appropriate trees further on in this chapter.


MODEM *
CONFIG KEY
MUX 1 *
CONFIG KEY
MUX 2 *
CONFIG KEY
PORT 1 *
CONFIG KEY
PORT n *
CONFIG KEY
NWK CTL *
CONFIG KEY
OP MODE:
MUX MOD:
PORT/CH
FLBK-O
FLBK-I
TIMING
STRP 01
STRP 02
LQ MODE
CLR CFM
ENTER
REINIT..
COMPLETE
RATE 1:
RATE 2:
RATE n
RATE 1
RATE 2
RATE n
DATA/CL
STRP 03
STRP 04
DATA/CL
STRP 2n+1.
STRP 2n+2
ADDRESS.
FSK RTE
DCP RTE:
STRP 21:

(available only on the 2680)

MODEM✳ Category

The MODEM Category allows you to configure transmit rate, operating mode, and various modem-related features.


MODEM ✳
CONFIG KEY
MUX 1 ✳
CONFIG KEY
MUX 2 ✳
CONFIG KEY
PORT 1 ✳
CONFIG KEY
PORT n ✳
CONFIG KEY
NWK CTL ✳
CONFIG KEY
OP MODE
MUX MOD
PORT/CH.
FLBK-O
FLBK-I:
TIMING:
STRP 01:
STRP 02:
LQ MODE
CLR CFM
ENTER
REINIT.
COMPLETE

OP MODE: Selects 1 of n operating modes.

MUX MOD: Selects mux mode 1 to n (see Chapter 2, Tables 2-4, 2-5, and 2-6). Will not be displayed if modem does not have mux options.

PORT/CH.: Selects port/channel assignment for multiplexing feature. Will not be displayed if modem does not have mux option.

FLBK-O: Overrides the outbound rate selected via the operating mode table. (Not selectable in "PP ARS" or ARS 19.2 modes.)

FLBK-I: Overrides the inbound rate selected via the operating mode table. When configured for point-to-point operation, this parameter is not selectable.

TIMING: Selects internal or external timing or port 1 to n timing.

STRP 01: Selects various modem parameters.

STRP 02: Selects various modem parameters.

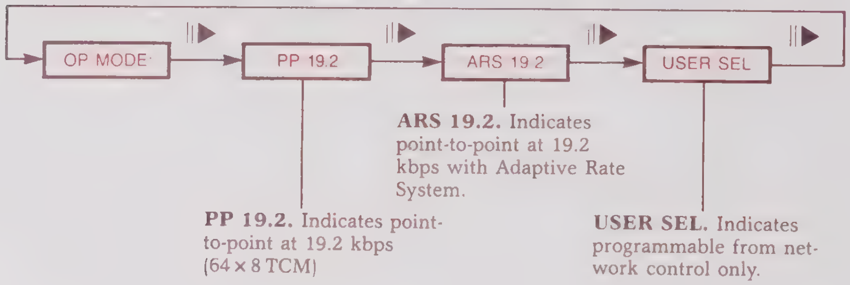
LQ MODE: Selects line quality mode (available only on the 2680)

REINIT.. This is used to clear the current configuration and return to standard default configuration. Pressing ENTER will result in display of REINIT.., followed by COMPLETE. ■**Note:** If in the remote mode, it is possible to issue this CLR CFM command and not get a response back (resulting in an error message) because the new configuration may have made the two modems incompatible over the secondary channel.

OP MODE:. The selectable operating modes will vary according to the 2600 Series model.

To select the operating mode, press the ENTER key when the desired mode is displayed on screen.

- **Model 2680 Operating Modes**

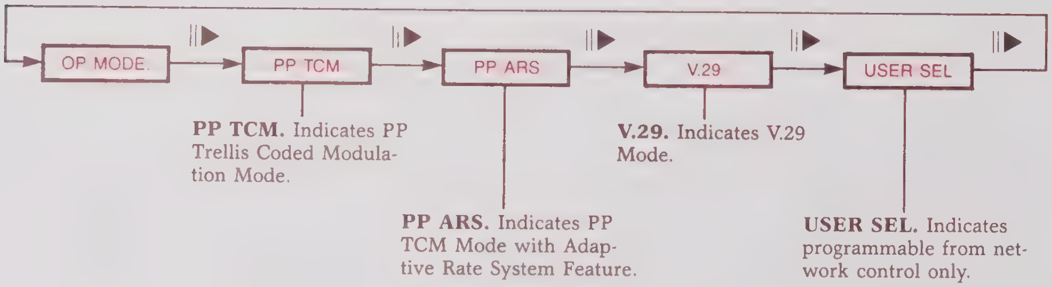


ARS 19.2. Indicates point-to-point at 19.2 kbps with Adaptive Rate System.

PP 19.2. Indicates point-to-point at 19.2 kbps (64 x 8 TCM)

USER SEL. Indicates programmable from network control only.

- **Model 2660 Operating Modes**



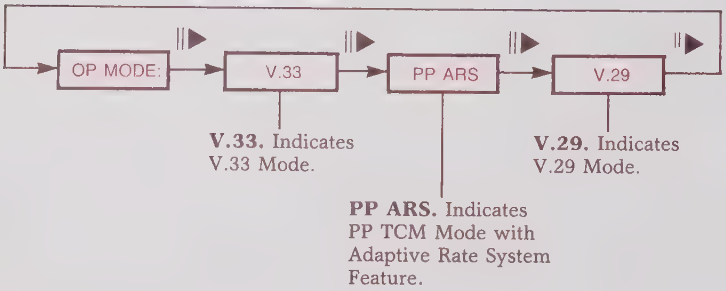
PP TCM. Indicates PP Trellis Coded Modulation Mode.

V.29. Indicates V.29 Mode.

PP ARS. Indicates PP TCM Mode with Adaptive Rate System Feature.

USER SEL. Indicates programmable from network control only.

- **Model 2666 Operating Mode**



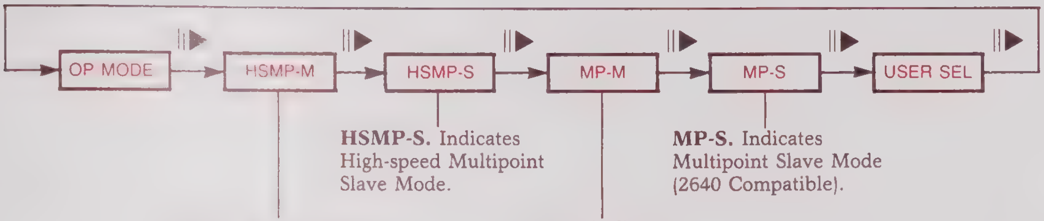
V.33. Indicates V.33 Mode.

V.29. Indicates V.29 Mode.

PP ARS. Indicates PP TCM Mode with Adaptive Rate System Feature.

■**Note:** When you have set the local and remote modems in the V.33 operating mode, they will operate at a speed that is defined by CCITT as the highest configured rate common to both modems. This means that asymmetric rates are not possible when the modems are operating in the V.33 mode. Thus, if you configure either modem for 12.0 kbps in the V.33 operating mode, then both units will transmit at that rate, even though one of the modems may have been configured for 14.4 kbps.

- **Model 2650 Operating Modes**


OP MODE
HSMP-M
HSMP-S
MP-M
MP-S
USER SEL

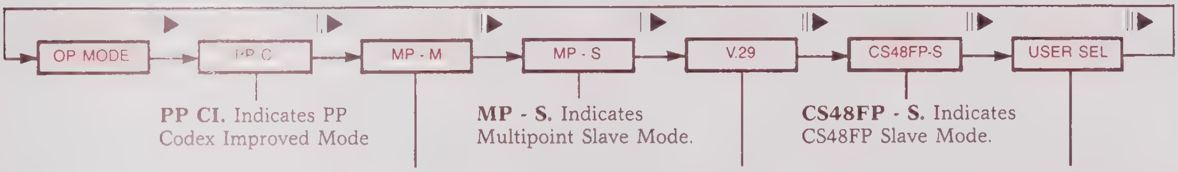
HSMP-S. Indicates High-speed Multipoint Slave Mode.

MP-S. Indicates Multipoint Slave Mode (2640 Compatible).

HSMP-M. Indicates High-speed Multipoint Master Mode.

MP-M. Indicates Multipoint Master Mode (2640 Compatible).

- **Model 2640 Operating Modes**


OP MODE
PP C
MP - M
MP - S
V.29
CS48FP-S
USER SEL

PP CI. Indicates PP Codex Improved Mode

MP - S. Indicates Multipoint Slave Mode.

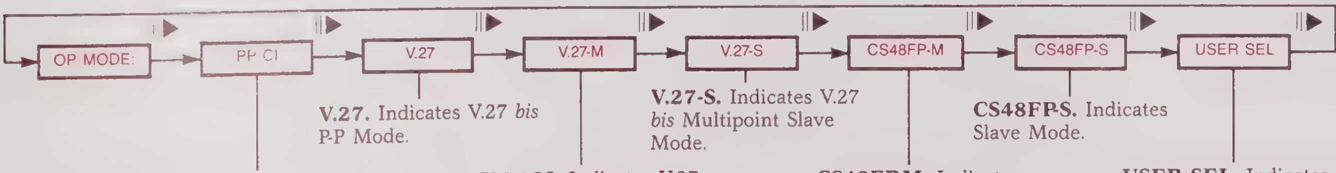
CS48FP - S. Indicates CS48FP Slave Mode.

MP - M. Indicates Multipoint Master Mode.

V.29. Indicates V.29 Mode.

USER SEL. Indicates programmable from network control only.

- **Model 2620 Operating Modes**


OP MODE:
PP CI
V.27
V.27-M
V.27-S
CS48FP-M
CS48FP-S
USER SEL

V.27-S. Indicates V.27 *bis* Multipoint Slave Mode.

V.27. Indicates V.27 *bis* P-P Mode.

CS48FP-S. Indicates Slave Mode.

PP CI. Indicates PP Codex Improved Mode at 4800 bps only.

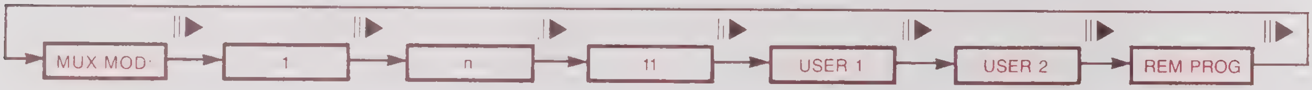
V.27-M. Indicates V.27 *bis* Multipoint Master Mode.

CS48FP-M. Indicates Master Mode.

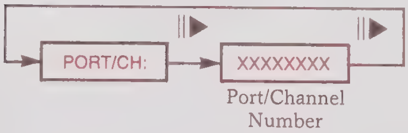
USER SEL. Indicates programmable from ne
work control only.

MUX MOD:. This selection allows you to choose the desired multiplexer mode. See the DTE Interface and Options section in Chapter 1 and the mux tables in Chapter 3 for explanations and instructions on multiplexing modes. The numbers displayed under this subcategory refer to the multiplexer choices of 1 through 11. (These mux mode selections, though numbers, are not numerical data but *parameters* . That is, you should not use the ADV # key to increase the number but should use the ||▶ key to move through the selections.) USER 1 is the same as Network Management Systems User-Defined Mux (UDM).

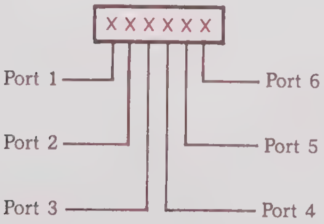
The Remote Programmable (REM PROG) mux mode is used only with the V.33 operating mode in the 2666 modem. When you select this mux mode on the local modem, it receives all mux mode information from the training sequence that is transmitted by the remote modem and configures itself accordingly. Thus, the remote unit controls (programs) the mux mode.



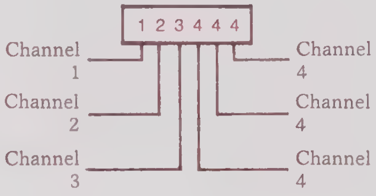
PORT/CH:. This selection allows you to make your port to channel assignment. Always assign Port 1 to an active channel; otherwise, you may have difficulty implementing loopback timing and modem testing and diagnostics. For a detailed explanation of port/channel assignment in the multiplexing feature, see Chapter 4. The port/channel control panel display of the Configuration functional area is defined below.



The position of the digit corresponds to the terminal port number (that is, EIA 232-C connection). See the display below for an example.



The actual number displayed corresponds to the multiplexed channel. For an example, see the following display.


1 2 3 4 4 4
Channel 1
Channel 2
Channel 3
Channel 4
Channel 4
Channel 4

The above configuration, then, has port 1 assigned to channel 1, port 2 to channel 2, port 3 to channel 3, and ports 4, 5, and 6 (MSU) to channel 4.

FLBK-O:. The selectable outbound rates displayed will vary according to the 2600 Series model and the operating mode selected, but will be a subset of those illustrated below. For example, if the PP TCM operating mode is chosen, the selectable outbound rates will be 16.8, 14.4, 12.0, and 9.6. Table 2-6 shows the selectable rates for each mode. ■ **Note:** In multipoint operation the FLBK-O and FLBK-I rates will always be seen from the point of view of the master modem.

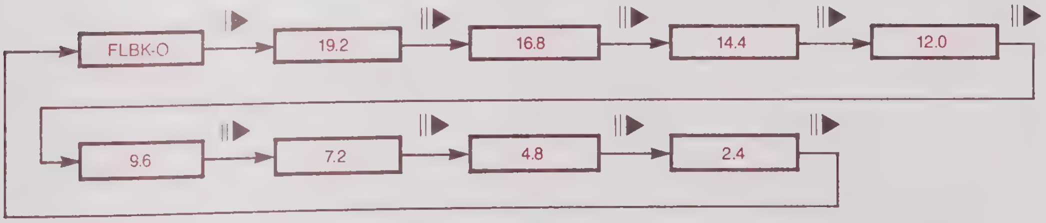
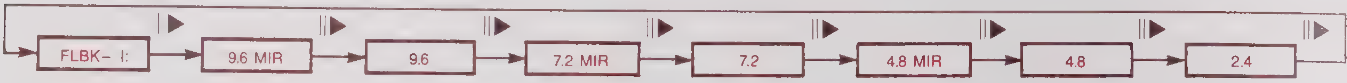

FLBK-O
19.2
16.8
14.4
12.0
9.6
7.2
4.8
2.4

*Table 2-6.
FLBK-O and FLBK-I Selections*

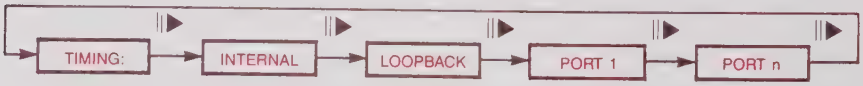
Operating Mode	*Selectable Inbound and Outbound Rates*
PP 19.2	19.2, 16.8, 14.4, 12.0
ARS 19.2	FLBK-O and FLBK-I cannot be selected. Automatically adjusts for 12.0 to 19.2 kbps, depending on line conditions.
PP ARS	FLBK-O and FLBK-I cannot be selected. Automatically adjusts for 9.6 to 16.8 kbps, depending on line conditions.
PP TCM	16.8, 14.4, 12.0, 9.6
V.33	14.4, 12.0
V.29	9.6, 7.2, 4.8
PP/CI	9.6, 7.2, 4.8
HSMP-M	16.8, 14.4, 12.0, 9.6
HSMP-S	9.6 MIR, 9.6, 7.2 MIR, 7.2, 4.8 MIR, 4.8
MP-M	9.6, 7.2, 4.8
MP-S	9.6 MIR, 9.6, 7.2 MIR, 7.2, 4.8 MIR, 4.8
CS48FP-M or -S	4.8, 2.4
V.27, V.27-M or -S	4.8, 2.4

■ **Note:** MIR rates are only available in FLBK-I.

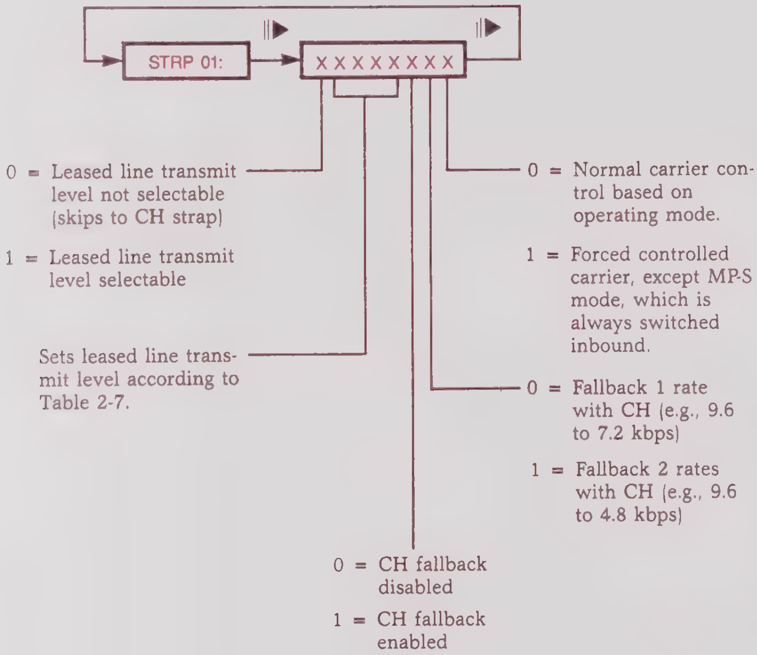
FLBK-I:. The selectable inbound rates displayed will vary according to the 2600 Series model and the operating mode selected, but will be a subset of those illustrated below. For example, if the MP-M operating mode is chosen, the selectable inbound rates will *not* include 9.6 MIR (Mixed Inbound Rates), 7.2 MIR, 4.8 MIR, or 2.4 MIR. Table 2-6 shows the selectable rates for each mode.



TIMING:. This selection allows the operator to choose the desired modem timing. See Chapter 1 for an explanation of the various modem timing choices and assistance in choosing the correct modem timing.



MODEM STRAP 01:. This strap allows you to select transmit level (see Table 2-7), enable/disable CH fallback, choose fallback rate, and select carrier control. ■ **Note:** The "0" strap setting is equal to the operating mode default. The "1" strap setting represents an optional or special situation.



0 = Leased line transmit level not selectable (skips to CH strap)

1 = Leased line transmit level selectable

Sets leased line transmit level according to Table 2-7.

0 = CH fallback disabled

1 = CH fallback enabled

0 = Normal carrier control based on operating mode.

1 = Forced controlled carrier, except MP-S mode, which is always switched inbound.

0 = Fallback 1 rate with CH (e.g., 9.6 to 7.2 kbps)

1 = Fallback 2 rates with CH (e.g., 9.6 to 4.8 kbps)

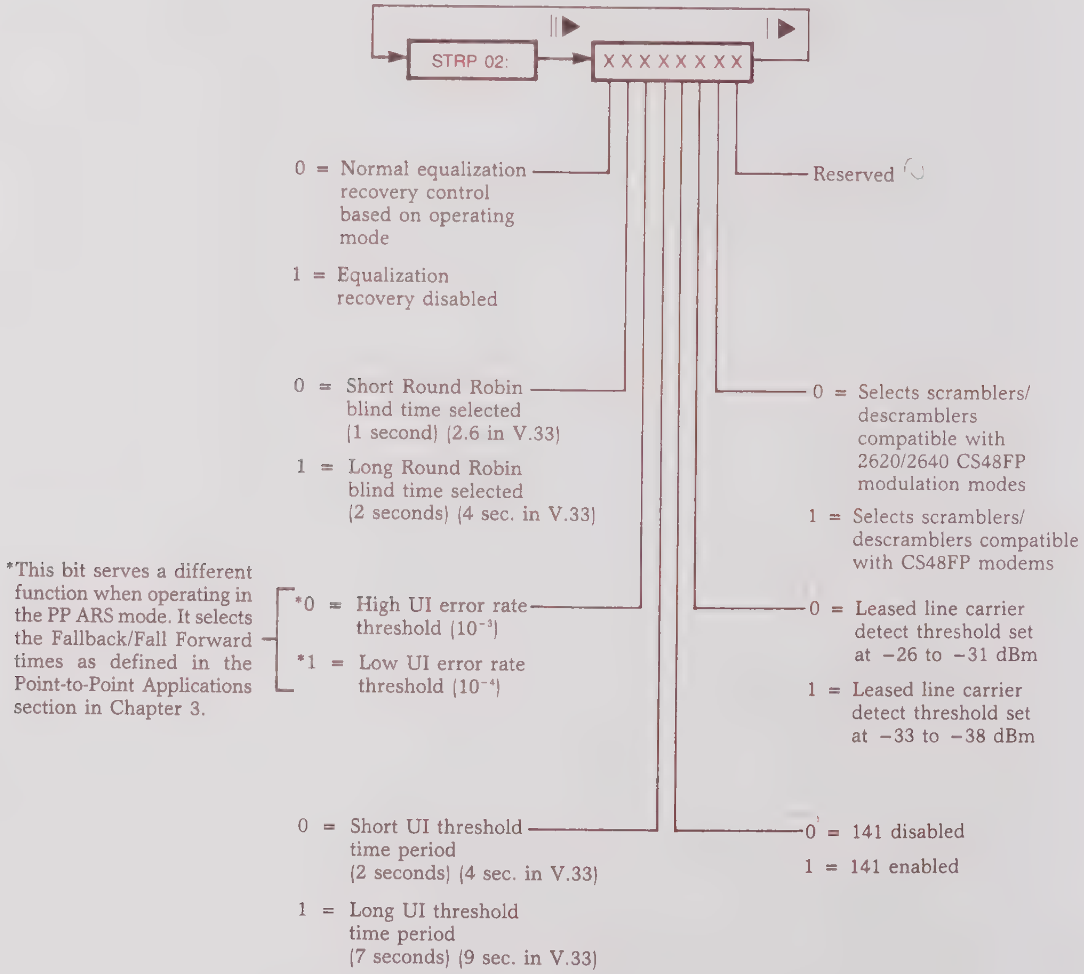
Table 2-7.
Transmit Level

Display	*Transmit Level*
x0000xxx =	0 dBm
x0001xxx =	−1 dBm
x0010xxx =	−2 dBm
x0011xxx =	−3 dBm
x0100xxx =	−4 dBm
x0101xxx =	−5 dBm
x0110xxx =	−6 dBm
x0111xxx =	−7 dBm
x1000xxx =	−8 dBm
x1001xxx =	−9 dBm
x1010xxx =	−10 dBm
x1011xxx =	−11 dBm
x1100xxx =	−12 dBm
x1101xxx =	−13 dBm
x1110xxx =	−14 dBm
x1111xxx =	−15 dBm

MODEM STRAP 02:. This strap allows you to select the following: Round Robin control; Round Robin blind time, UI error rate threshold, Adaptive Rate Fallback/Fall Forward times if in ARS 19.2 or PP ARS mode, and UI threshold time period (see note on bit 3 of Strap 02 below, and Table 2-8). You can also enable/disable Circuit 141, set leased line carrier detect threshold, and select CS48FP scramblers/descramblers. ■ **Note:** The "0" strap setting is equal to the operating mode default. The "1" strap setting represents an optional or special situation.

Table 2-8.
Adaptive Rate Selections

Parameter	*0 Setting*	*1 Setting*
Fall Forward Time	8 minutes	15 minutes
Fallback Time	2 minutes	3 minutes
Fallback No. of UIs	3 UIs	6 UIs



0 = Normal equalization recovery control based on operating mode
1 = Equalization recovery disabled

0 = Short Round Robin blind time selected (1 second) (2.6 in V.33)
1 = Long Round Robin blind time selected (2 seconds) (4 sec. in V.33)

*0 = High UI error rate threshold (10^{-3})
*1 = Low UI error rate threshold (10^{-4})

*This bit serves a different function when operating in the PP ARS mode. It selects the Fallback/Fall Forward times as defined in the Point-to-Point Applications section in Chapter 3.

0 = Short UI threshold time period (2 seconds) (4 sec. in V.33)
1 = Long UI threshold time period (7 seconds) (9 sec. in V.33)

Reserved

0 = Selects scramblers/descramblers compatible with 2620/2640 CS48FP modulation modes
1 = Selects scramblers/descramblers compatible with CS48FP modems

0 = Leased line carrier detect threshold set at −26 to −31 dBm
1 = Leased line carrier detect threshold set at −33 to −38 dBm

0 = 141 disabled
1 = 141 enabled

Line Quality Feature

The Line Quality feature in the 2680 lets you take advantage of better line conditions and attain greater effective data throughput for certain types of applications. Please see the Line Quality feature section in Chapter 3 for a detailed explanation of this feature and its benefits. That section also contains guidelines for choosing the appropriate line quality selection. The Line Quality feature allows you to balance error performance and throughput delay to maximize effective data throughput based on operating conditions.

Configure the Line Quality feature from the MODEM tree. After pressing ENTER, the selected mode will flash*. Advance through the available options as you would for other parameters.

These are your configuration options:

LQ=1 (highest error performance, standard throughput delay)

LQ=2 (high error performance, low throughput delay)

LQ=3 (lower error performance, very low throughput delay)

Configuration Guidelines. The following guidelines will help you determine which setting to use.

- ***LQ1.*** LQ1 is the initial selection and is recommended for operation over the widest range of D1-conditioned lines or for noisy or disruptive lines. LQ1 offers the highest error performance and has the highest throughput delay.
- ***LQ2.*** With only moderate throughput delay, LQ2 will yield higher throughput than LQ1 over better lines.
- ***LQ3.*** When lines are clean and have little noise, LQ3 provides the highest data throughput.

The initial configuration of both modems should always be LQ1. In general, the operator will experience better throughput by operating at 19.2 kbps with the highest LQ setting that yields acceptable error performance. Acceptable error performance is subjective and will depend on local operating criteria. One indication of unacceptable error performance is that the modem will either retrain and fall back to a lower speed if configured in ARS, or retrain frequently if configured in PP-19.2. A second indication is the CQMS Error Probability. A reading of < 30 usually indicates an acceptable error rate. Generally, less than 1 error per 1000 blocks of transmitted data is deemed acceptable.

You can make a more exact determination of your requirements by running the test described below.

1) Set both modems to run in LQ1. Exercise the system by running a batch job (or file transfer) which requires 10 to 20 minutes to complete. Time stamp the job and record the total time required to run the test in LQ1.
2) Set both modems to LQ2 and run the same job again, recording the time required.
3) Repeat for LQ3.

The test results indicate the cumulative effect that protocol, LQ feature selection, and analog line quality have on data throughput. The LQ choice which yields the shortest time for a given job is the best compromise between modem throughput delay and error correction capability.

The two modems should be configured to run in the same or compatible modes. LQ1 is not compatible with LQ2 or LQ3. LQ2 and LQ3 are compatible modes. This means that if one modem is configured in LQ2 and the other modem is configured in LQ3, each modem will receive in the configured mode. If the modems are configured in incompatible modes, they will automatically synchronize to run in LQ1.

---

* Prior revision modems all operate as if configured in LQ1. (These modems will not have LQ displays in either the MODEM or GENERAL category.)

The following table shows the actual operating mode which results from any given configured mode.

MODEM tree *Configuration* *Modem 1*	*Modem 2*	*GENERAL tree* *Status* *Modem 1*	*Modem 2*
LQ1	LQ1	LQ1	LQ1
LQ1	LQ2	LQ1	LQ1
LQ1	LQ3	LQ1	LQ1
LQ2	LQ2	LQ2	LQ2
LQ2	LQ3	LQ2	LQ3
LQ3	LQ2	LQ3	LQ2
LQ3	LQ3	LQ3	LQ3

If both modems are configured for LQ1, they will run in LQ1. If one modem is configured to LQ1, and the other is configured to either LQ2 or LQ3, the modems operate in LQ1. A 2680 Modem without the LQ feature runs automatically in LQ1 at all times.

IMPORTANT

Compatible mode selection relies on training information, which is controlled by the Round Robin strap. Do not disable Round Robin (Strap 2).

Monitoring Line Quality. You can monitor (read only) the Line Quality mode in the GENERAL tree. If the configured Line Quality mode and the status differ, you have not consistently configured both modems. In this case, the modems will select compatible modes according to the table on this page.

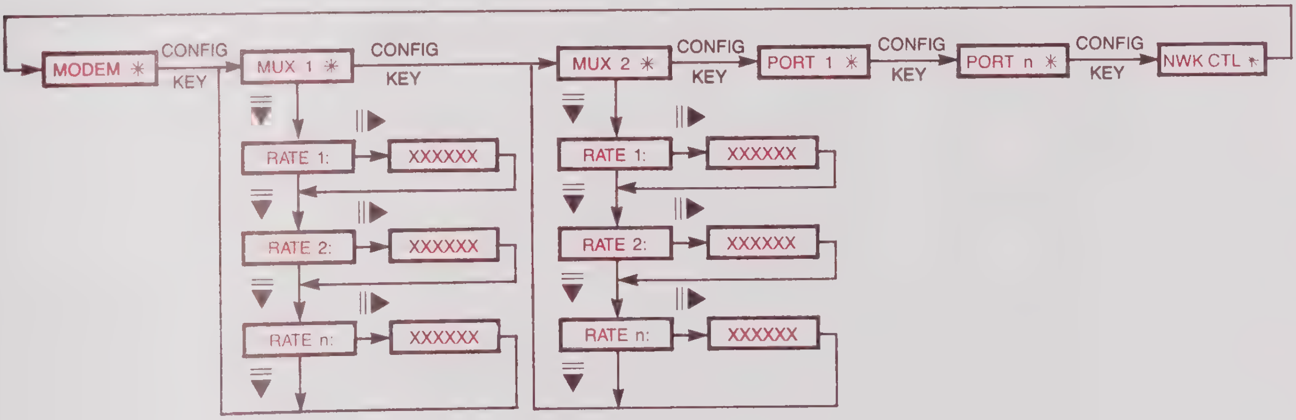
The MODEM category, within CONFIG, will always show the Line Quality setting you selected. The GENERAL category, within STATUS, will show the actual operating mode. The MODEM and GENERAL Line Quality displays will only differ when the two modems are configured with incompatible Line Quality selections.

Occasionally you may see LQ=%%%% on the display window of your modem. It indicates that the two modems have not yet established compatible line quality modes. ''%%%%'' (no Line Quality mode active) is a transient state only.

MUX 1✳ and MUX 2✳ Categories

The MUX 1 and MUX 2 categories allow you to configure mux modes for both local and remote modems. When you select a main channel rate at the local modem, you can choose a mux mode that suits the requirements of that rate. ■ **Note:** To activate either of these mux modes, go to the MUX MOD: subcategory under MODEM✳ and select the USER 1 parameter for MUX 1✳ or the USER 2 parameter for MUX 2✳. Observe that USER 1 on the Control Panel is the same as the user-defined mux on Network Management Systems, which will overwrite USER 1 data with values from its own database when it attaches the modem.

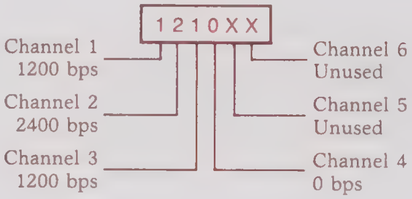
When you are in the V.33 operating mode, select the REM PROG parameter under the MUX MOD: subcategory. The REM PROG option is useful when you want to be certain that the local modem is configured the same way as the remote.


MODEM ✳
CONFIG KEY
MUX 1 ✳
CONFIG KEY
MUX 2 ✳
CONFIG KEY
PORT 1 ✳
CONFIG KEY
PORT n ✳
CONFIG KEY
NWK CTL ✳
RATE 1:
XXXXXX
RATE 2:
XXXXXX
RATE n:
XXXXXX
RATE 1:
XXXXXX
RATE 2:
XXXXXX
RATE n:
XXXXXX

XXXXXX = Four or six channel rates; if only four channels are possible, the modem will not record additional entries.

■ **Note:** If the CLR CFM command is entered and the rates you have selected are deleted from memory, default values will appear on the display. These values are listed in Chapter 3.

Channel Rates Selected as Parameters. The listing below gives the channel rates available and the corresponding digit codes that you use to strap the mux mode. The example illustrates a possible configuration using a 4-channel 9600 modem when the selected main channel rate is 4.8 kbps. You must always assign channels from left to right. Do not skip any channel by leaving a "0" bandwidth to the left of an active channel. (However, a descending order of selection is not required.) ■ **Note:** If the sum of channel rates is *less* than the main channel rate, an ALERT 10 message will be displayed. However, you can still perform the configuration.


1 2 1 0 X X
Channel 1
1200 bps
Channel 2
2400 bps
Channel 3
1200 bps
Channel 6
Unused
Channel 5
Unused
Channel 4
0 bps

The sum of channel rates = 4.8 kbps (4800 bps)

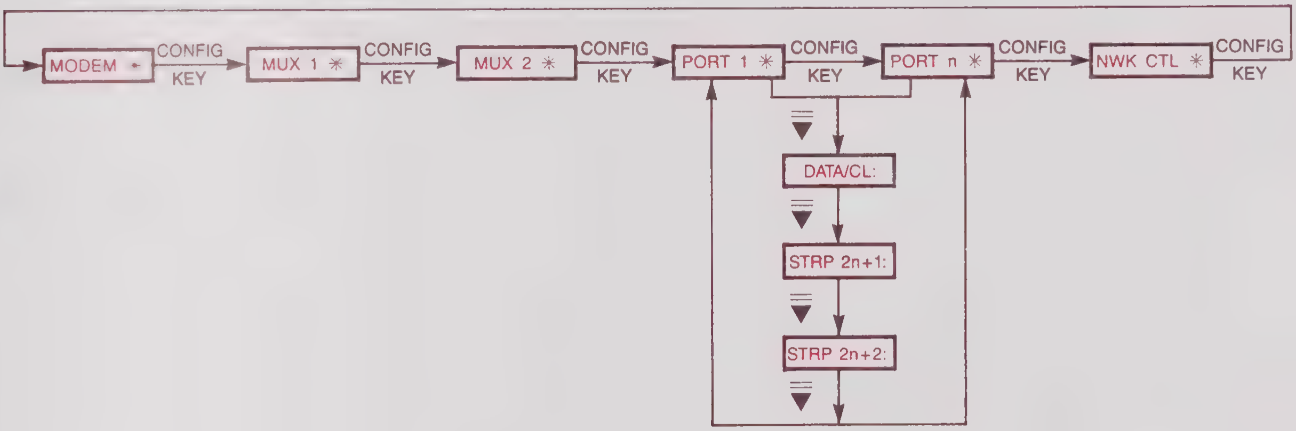
Key for Channel Rates

0 = 0 bps
1 = 1200 bps
2 = 2400 bps
3 = 4800 bps
4 = 7200 bps
5 = 9600 bps
6 = 12000 bps
7 = 14400 bps
8 = 16800 bps
9 = 19200 bps

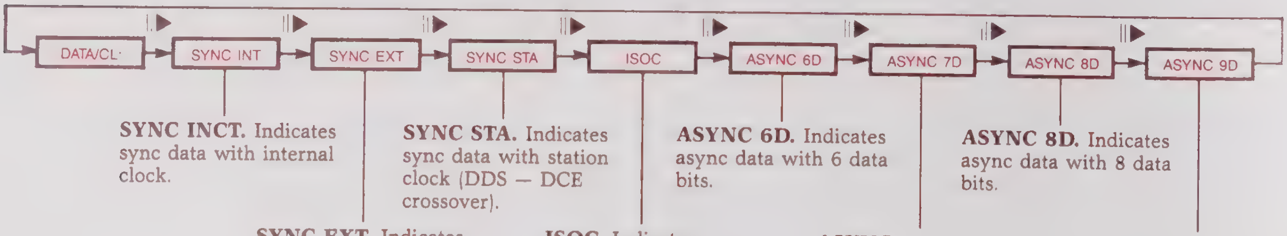
PORT n✳ Category

The Port n Category allows selection of various port operating parameters. There are two straps for each port. Therefore, straps 03 and 04 apply to Port 1, straps 05 and 06 apply to Port 2, and so forth, up to straps 13 and 14, which apply to Port 6. The following selections are available under the PORT n✳ Category:

- **DATA/CL:.** This selects the data type (async, sync, isoc), clock if async, or number of bits if async.
- **STRP 2n + 1: and STRP 2n + 2:.** These select various port parameters.


MODEM ✳
CONFIG KEY
MUX 1 ✳
CONFIG KEY
MUX 2 ✳
CONFIG KEY
PORT 1 ✳
CONFIG KEY
PORT n ✳
CONFIG KEY
NWK CTL ✳
CONFIG KEY
DATA/CL:
STRP 2n+1:
STRP 2n+2:

DATA/CL:. This selection allows you to select the data type (async, sync, isoc), clock if sync, or number of bits if async. See Chapter 1 for an explanation of the various port timing choices and for assistance in choosing the correct port timing.



SYNC INCT. Indicates sync data with internal clock.

SYNC EXT. Indicates data with external clock (DCE — DCE crossover).

SYNC STA. Indicates sync data with station clock (DDS — DCE crossover).

ISOC. Indicates isochronous data (no clocks used or tracked).

ASYNC 6D. Indicates async data with 6 data bits.

ASYNC 7D. Indicates async data with 7 data bits.

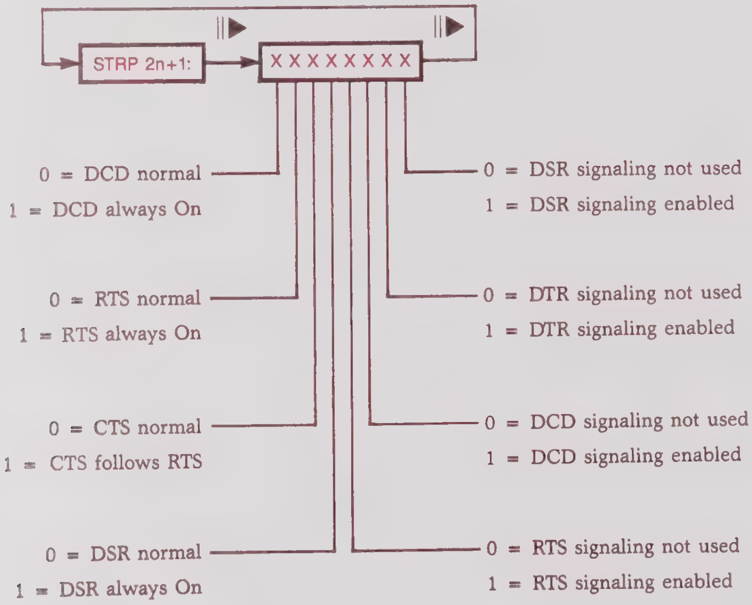
ASYNC 8D. Indicates async data with 8 data bits.

ASYNC 9D. Indicates async data with 9 data bits.

■**Notes:** 1) The ASYNC 6D through ASYNC 9D selections include data bits and parity bits. They do not include start and stop bits. For example, if you have six data bits and one parity bit you should select ASYNC 7D.

2) When using a 5-bit Baudot code with two stop bits, you should select ASYNC 6D. You cannot use 1.5 stop bits with the 5-bit Baudot code. If you do, the async/sync converter will not function.

PORT STRAP 2n + 1:. This port strap allows you to select the normal or always On setting for the following signals: DCD, RTS, CTS, DSR. In addition, this strap allows you to enable/disable the DSR, DCD, DTR, and RTS signals. These definitions apply to straps 03, 05, 07, 09, 11, and 13. ■ **Note:** The "0" strap setting is equal to the operating mode default. The "1" strap setting represents an optional or special situation.


STRP 2n+1:
XXXXXXXX
0 = DCD normal
1 = DCD always On
0 = RTS normal
1 = RTS always On
0 = CTS normal
1 = CTS follows RTS
0 = DSR normal
1 = DSR always On
0 = DSR signaling not used
1 = DSR signaling enabled
0 = DTR signaling not used
1 = DTR signaling enabled
0 = DCD signaling not used
1 = DCD signaling enabled
0 = RTS signaling not used
1 = RTS signaling enabled

PORT STRAP 2n + 2:. This port strap allows you to select RTS/CTS delay, to enable/disable remote loopback detect, and to enable/disable Circuit 140. These definitions apply to straps 04, 06, 08, 10, 12, and 14. ■ **Note:** The "0" strap setting is equal to the operating mode default. The "1" strap setting represents an optional or special situation.

There are seven RTS/CTS delay selections available ranging from 0 ms to 75 ms. However, the longer RTS/CTS delays are not always possible at the higher port rates. See Table 2-9 for *actual* RTS/CTS delay times.

These delays are generally used with constant carrier muxports, but if they are used in switched carrier, they are added to the training time. The "CTS follows RTS" strap selection overrides RTS/CTS delays.

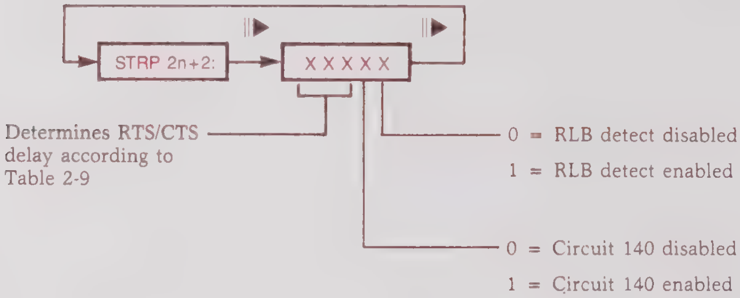
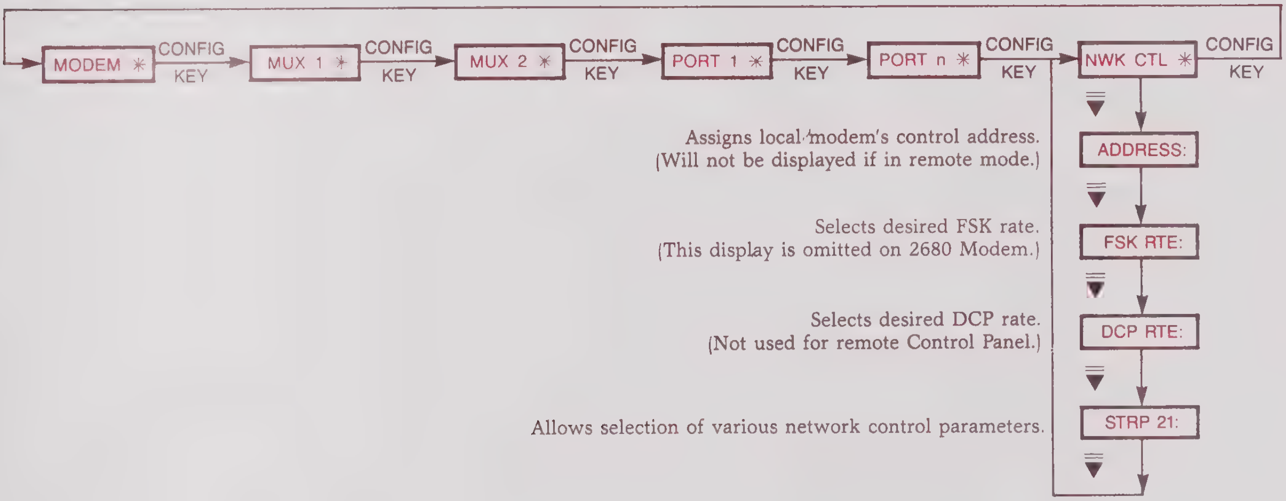

STRP 2n+2:
X X X X X
Determines RTS/CTS delay according to Table 2-9
0 = RLB detect disabled
1 = RLB detect enabled
0 = Circuit 140 disabled
1 = Circuit 140 enabled

Table 2-9.
Actual RTS/CTS Delay (ms) ±5 ms

	Delay Settings (ms)							
Port Rate (kbps)	*000xx*	*001xx*	*010xx*	*011xx*	*100xx*	*101xx*	*110xx*	*111xx*
1.2	0	15	30	75	150	300	750	750
2.4	0	15	30	75	150	300	750	750
4.8	0	15	30	75	150	300	300	300
7.2	0	15	30	75	150	150	150	150
9.6	0	15	30	75	150	150	150	150
12.0	0	15	30	75	150	150	150	150
14.4	0	15	30	75	75	75	75	75
16.8	0	15	30	75	75	75	75	75
19.2	0	15	30	75	75	75	75	75

NWK CTL✳ Category

The NetWorK ConTroL Category allows you to configure various operating parameters for the network control communications system channel. Both Network Management Systems and the remote Control Panel use the control channel in either FSK or embedded modulation. The 2600 control channel digital port (EIA connector) can be set for a rate different from the control channel itself. When the two rates are the same, a hardware connection exists between the connector and the control channel. When the two rates are different, the modem software buffers the half-duplex network control channel protocol. The control channel is protocol-sensitive for the Network Management System protocol and is not suitable as a user channel.


MODEM ✳
CONFIG KEY
MUX 1 ✳
CONFIG KEY
MUX 2 ✳
CONFIG KEY
PORT 1 ✳
CONFIG KEY
PORT n ✳
CONFIG KEY
NWK CTL ✳
CONFIG KEY
ADDRESS:
FSK RTE:
DCP RTE:
STRP 21:

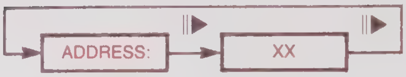
Assigns local modem's control address.
(Will not be displayed if in remote mode.)

Selects desired FSK rate.
(This display is omitted on 2680 Modem.)

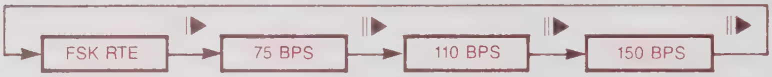
Selects desired DCP rate.
(Not used for remote Control Panel.)

Allows selection of various network control parameters.

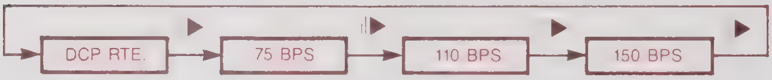
ADDRESS:. This selection allows you to assign the local modem's network control hexadecimal address. This selection is not displayed if the modem is in the remote mode.



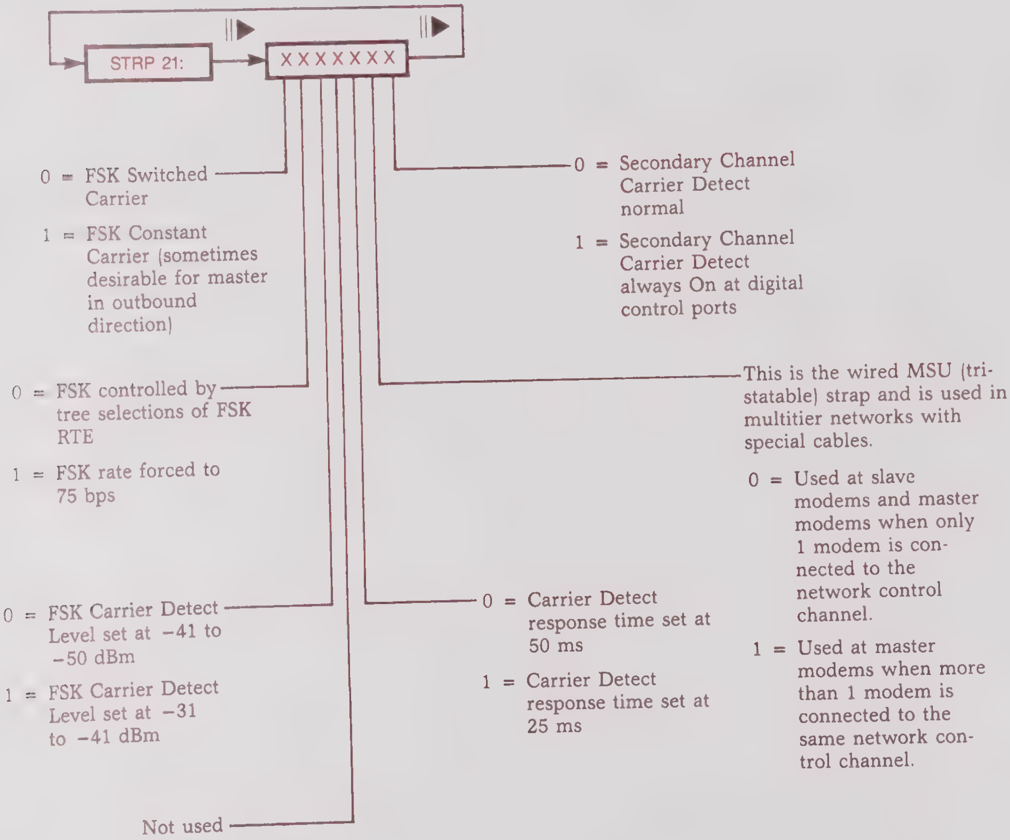
FSK RTE:. This selection allows you to select from three possible FSK rates. 75 bps is recommended for compatibility with previous Codex modem products in the same Network Management System. Note that 150 bps should be used with the CS48FP or V.27 *bis* operating modes only.


FSK RTE
75 BPS
110 BPS
150 BPS

DCP RTE:. This selection allows you to select from three possible Digital Control Port rates.


DCP RTE.
75 BPS
110 BPS
150 BPS

Network Control STRP 21:. This strap allows you to select various parameters for the network control communications system. ■ **Note:** The "0" strap setting is equal to the operating mode default. The "1" strap setting represents an optional or special situation.



0 = FSK Switched Carrier

1 = FSK Constant Carrier (sometimes desirable for master in outbound direction)

0 = FSK controlled by tree selections of FSK RTE

1 = FSK rate forced to 75 bps

0 = FSK Carrier Detect Level set at −41 to −50 dBm

1 = FSK Carrier Detect Level set at −31 to −41 dBm

Not used

0 = Carrier Detect response time set at 50 ms

1 = Carrier Detect response time set at 25 ms

This is the wired MSU (tri-statable) strap and is used in multitier networks with special cables.

0 = Used at slave modems and master modems when only 1 modem is connected to the network control channel.

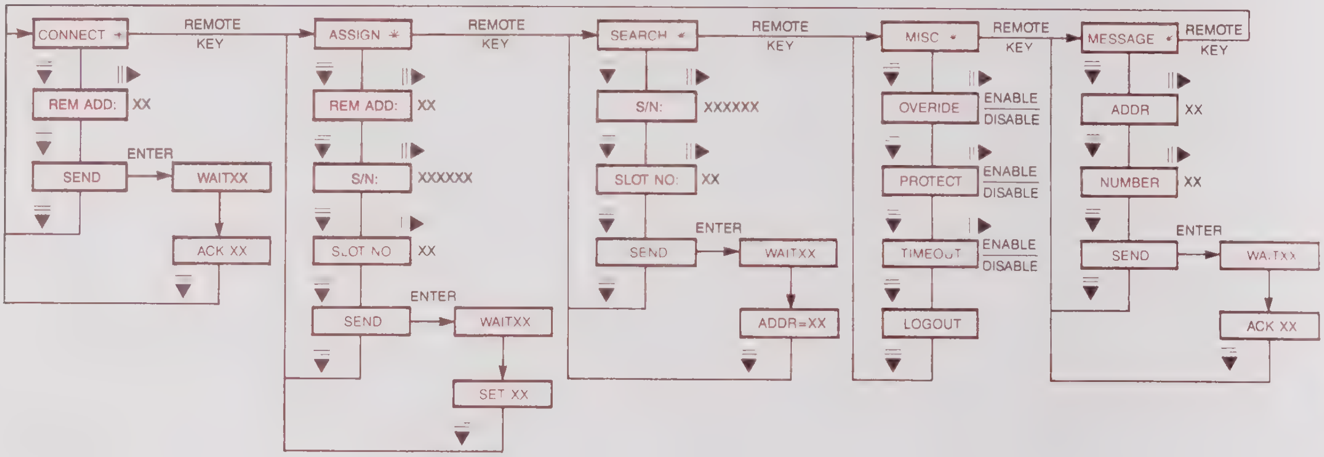
1 = Used at master modems when more than 1 modem is connected to the same network control channel.

0 = Secondary Channel Carrier Detect normal

1 = Secondary Channel Carrier Detect always On at digital control ports

REMOTE TREE

The REMOTE functional area allows you to establish a connection with a remote unit, assign a network control address, search for a network control address, enable/disable remote control override, enable/disable timeout function, log out, enable/disable password protection, or send a user message to a remote unit.


CONNECT
REMOTE KEY
REM ADD:
XX
SEND
ENTER
WAITXX
ACK XX
ASSIGN
REMOTE KEY
REM ADD:
XX
S/N:
XXXXXX
SLOT NO
XX
SEND
ENTER
WAITXX
SET XX
SEARCH
REMOTE KEY
S/N:
XXXXXX
SLOT NO:
XX
SEND
ENTER
WAITXX
ADDR=XX
MISC
REMOTE KEY
OVERIDE
ENABLE
DISABLE
PROTECT
ENABLE
DISABLE
TIMEOUT
ENABLE
DISABLE
LOGOUT
MESSAGE
REMOTE KEY
ADDR
XX
NUMBER
XX
SEND
ENTER
WAITXX
ACK XX

Remote Operation

The REMOTE key can be used to access the Remote Tree and to establish a connection with a remote unit.

To perform any type of operation on a remote unit (that is, status, test, or configuration), first enter the Remote Tree and choose the category, CONNECT✳. Complete the connection by entering the address of the remote control unit; the REMOTE LED will then flash. At this point, you can press one of the other three functional area keys to enable remote operation within that functional area.

For example, after you have made a connection, if you then press the STATUS key, the information displayed will apply to the remote modem. A visual indication that the modem is in remote operation is given by the flashing LED on the REMOTE key and the steady illumination of the LED on the STATUS key. ■ **Note:** If the modem is in remote operation (that is, connected to a remote modem), when you initially enter one of the Control Panel trees the display will give the message ''WAIT xx''. The xx represents a countdown, in seconds, while the information is being processed.

Serial Number/Remote Control Addressing

Each 2600 Series Modem uses a 6-digit modem serial number that is used to search for or assign a remote control address. ■ **Note:** Nested modems use the slot number for modem numbering within the nest. In the standalone 2600, the slot number is always 00.

Use the ASSIGN✳ Category of the Remote Tree when you know the serial number of the remote unit and you need to assign a remote control address to that unit. Use the SEARCH✳ Category of the Remote Tree when you know the serial number of the remote unit and you need to learn the address of that unit.

If you know the address of a remote unit and you want to find the remote unit serial number, perform the following steps:

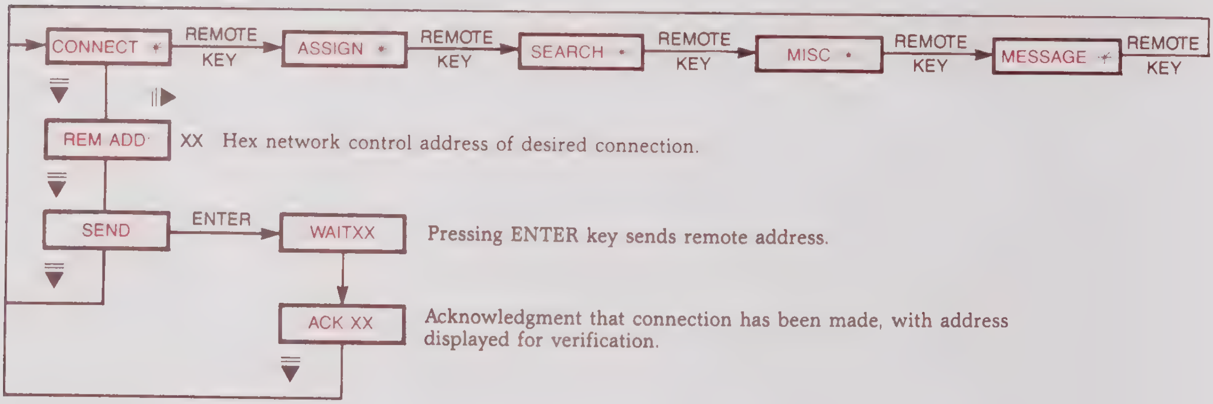
1) Access the Remote Tree.
2) Enter the CONNECT✳ Category.
3) Establish a connection by entering the control address of the remote unit.
4) Enter the GENERAL✳ Category to find the serial number of the Status Tree.

CONNECT✳ Category

The CONNECT Category allows you to connect to a remote unit by inputting the network control address of this remote unit. Once the connection has been made, you control the remote unit. All TEST, CONFIGURATION, and STATUS operations implemented will be performed for the remote unit. Pressing the REMOTE key again will cause the modem to disconnect. While connected to another modem, you cannot access any other category within the Remote Tree.

When a connection has been made, the LED on the REMOTE key will flash on and off at the local modem, and the NC LED at the *remote* modem will go on.

When disconnecting (by again pressing the REMOTE key), the display will respond with a WAIT count-down and then return to the default display (current operating mode).


CONNECT ✳
REMOTE KEY
ASSIGN •
REMOTE KEY
SEARCH •
REMOTE KEY
MISC •
REMOTE KEY
MESSAGE ✳
REMOTE KEY
REM ADD
XX
SEND
ENTER
WAITXX
ACK XX

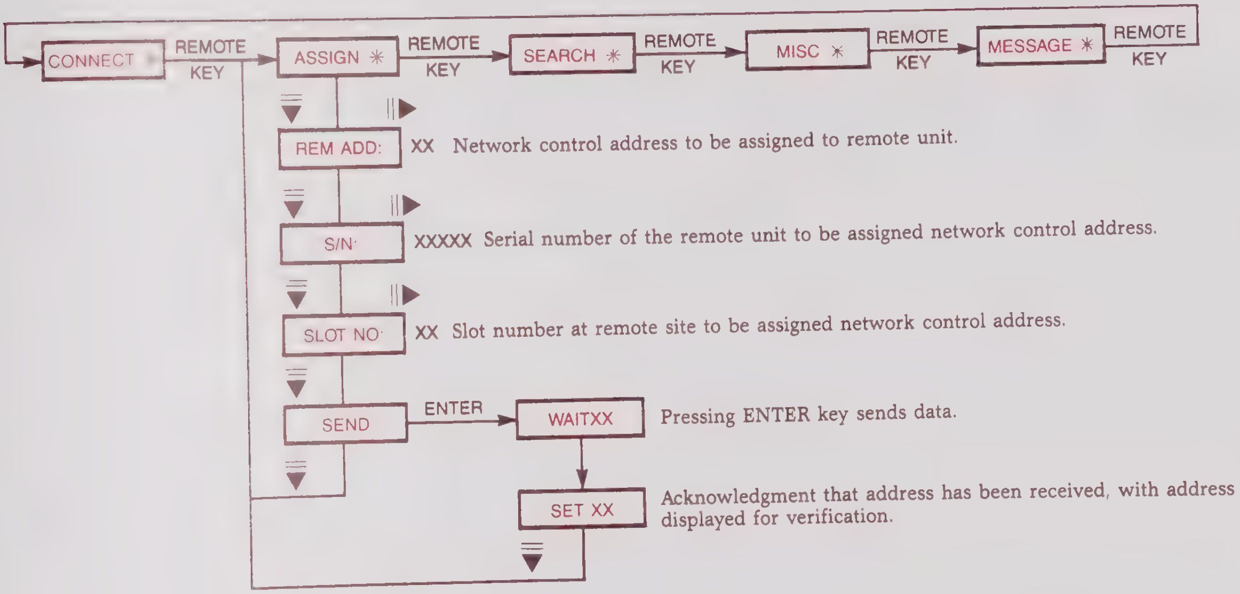
Hex network control address of desired connection.

Pressing ENTER key sends remote address.

Acknowledgment that connection has been made, with address displayed for verification.

ASSIGN✳ Category

The ASSIGN Category allows you to assign a network control address to a remote unit. Up to 254 addresses are available (01 through FE).


CONNECT ✳
REMOTE KEY
ASSIGN ✳
REMOTE KEY
SEARCH ✳
REMOTE KEY
MISC ✳
REMOTE KEY
MESSAGE ✳
REMOTE KEY
REM ADD:
S/N:
SLOT NO:
SEND
ENTER
WAITXX
SET XX

XX Network control address to be assigned to remote unit.

XXXXX Serial number of the remote unit to be assigned network control address.

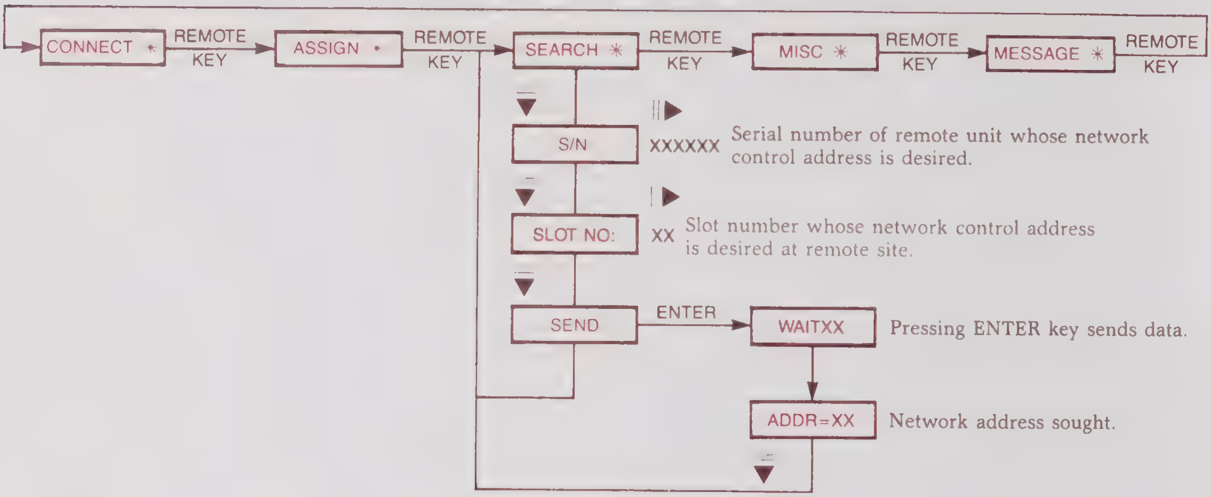
XX Slot number at remote site to be assigned network control address.

Pressing ENTER key sends data.

Acknowledgment that address has been received, with address displayed for verification.

SEARCH✳ Category

The SEARCH Category is used to find a modem's network control address based on the modem's serial number. When you enter the serial number, the display will respond with the proper network control address.


CONNECT ✳
REMOTE KEY
ASSIGN •
REMOTE KEY
SEARCH ✳
REMOTE KEY
MISC ✳
REMOTE KEY
MESSAGE ✳
REMOTE KEY
S/N
XXXXXX
SLOT NO:
XX
SEND
ENTER
WAITXX
ADDR=XX

Serial number of remote unit whose network control address is desired.

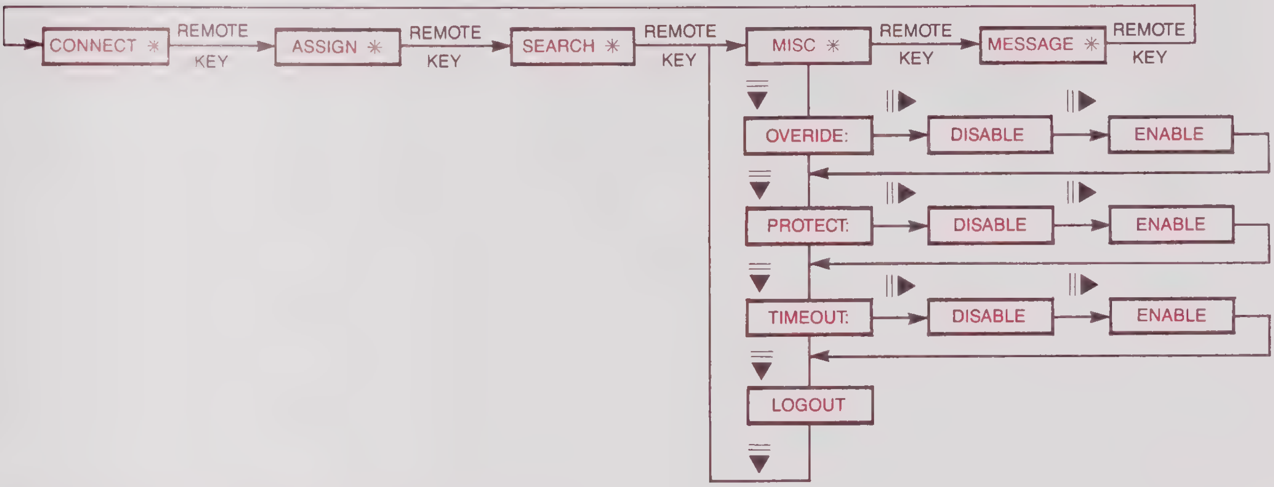
Slot number whose network control address is desired at remote site.

Pressing ENTER key sends data.

Network address sought.

MISC✳ Category

The MISCellaneous Category allows you to log out, enable/disable password protection, enable/disable timeout, and enable/disable remote control override.


CONNECT ✳
REMOTE KEY
ASSIGN ✳
REMOTE KEY
SEARCH ✳
REMOTE KEY
MISC ✳
REMOTE KEY
MESSAGE ✳
REMOTE KEY
OVERIDE:
DISABLE
ENABLE
PROTECT:
DISABLE
ENABLE
TIMEOUT:
DISABLE
ENABLE
LOGOUT

The following selections are available under the MISC✳ Category:

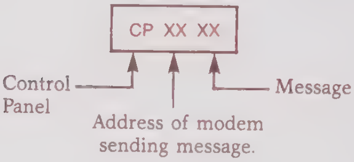
- **OVERIDE:**. If OVERIDE is enabled, the modem may be controlled by only the local Control Panel. If disabled, the modem may be controlled by the local Control Panel, remote modem Control Panel, or Network Control.
- **PROTECT:**. PROTECT enables/disables password protection.
- **TIMEOUT:**. If TIMEOUT is enabled, it will automatically log you out after a 10-minute period in which there have been no operator actions. The display then returns to default display (current operating mode).
- **LOGOUT**. LOGOUT causes the modem to exit the Remote functional area and returns the display to the default display (current operating mode). If the password protection is enabled, the password would again have to be entered to access any area covered by password protection.

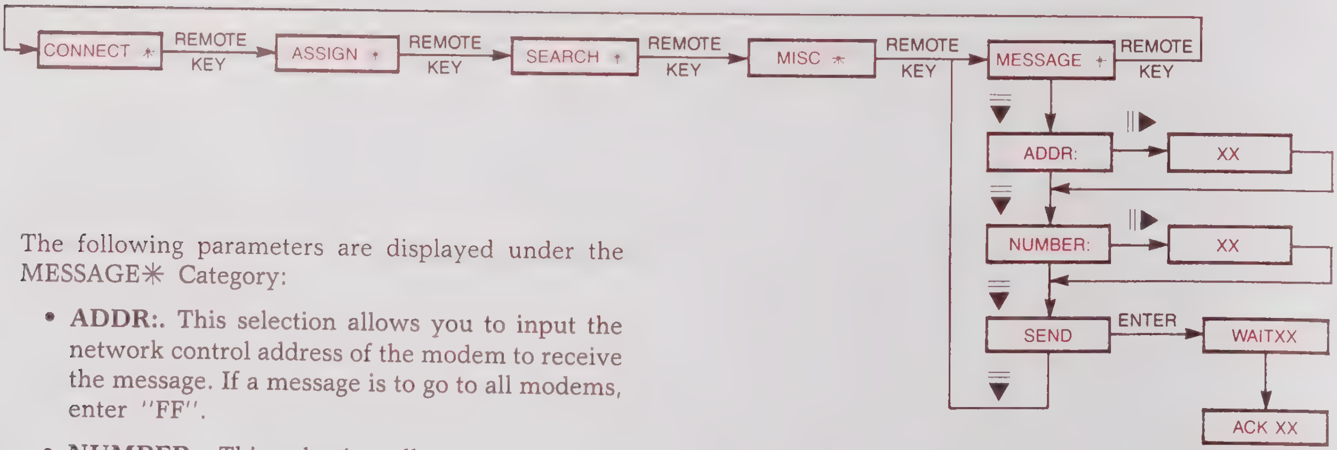
MESSAGE✳ Category

The MESSAGE Category allows you to enter a 2-digit user message to be sent to a remote unit or all remote units. Up to 100 messages are available. This message would correspond with a user-compiled list designed for internal use. For example, entering ''35'' could mean ''Call home office.''

At the receiving modem, the message will flash on the display, replacing whatever *had* been appearing on the display. The message keeps flashing until you manually return the modem to your desired display.

At the receiving modem, the message will come up in the following format.


CP XX XX
Control Panel
Address of modem sending message.
Message


CONNECT ✳
REMOTE KEY
ASSIGN ✳
REMOTE KEY
SEARCH ✳
REMOTE KEY
MISC ✳
REMOTE KEY
MESSAGE ✳
REMOTE KEY
ADDR:
XX
NUMBER:
XX
SEND
ENTER
WAITXX
ACK XX

The following parameters are displayed under the MESSAGE✳ Category:

- **ADDR:.** This selection allows you to input the network control address of the modem to receive the message. If a message is to go to all modems, enter ''FF''.
- **NUMBER:.** This selection allows you to input the 2-digit user message.
- **SEND.** When SEND is displayed, press ENTER to send a message.
- **ACK XX.** The ACK XX display is the acknowledgment that the message has been received, with the address of the receiving unit. If the message has been sent to all modems, the display will respond with ACK.

CONFIGURING THE 2600 SERIES

You should complete the following configuration worksheets, which are based on Network Management Systems and Control Panel application information, when initially strapping and then whenever you are checking or inputting configuration data. Use a pencil in order to accommodate future changes in the configuration. You may complete the sheets before actually configuring the modem or at the same time that you are inputting the data. Since the configuration data is stored on the DTE card, these sheets represent the only copy of your configuration information should the DTE card be replaced. Therefore, be sure to update them before replacing a DTE card.

Modem Configuration

- ***Operating Mode***

☐ PP 19.2
☐ V.33
☐ CS48FP-M
☐ V.27 *bis* MP-S
☐ ARS 19.2
☐ V.29
☐ CS48FP-S
☐ User Special
☐ PP TCM
☐ HSMP-M
☐ V.27 *bis* PP
☐ PP ARS
☐ HSMP-S
☐ V.27 *bis* MP-M
☐ PP CI
☐ MP-M

- ***Mux Mode***

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9
☐ 10 ☐ 11 ☐ User Configurable 1 ☐ User Configurable 2 ☐ Remote Programmable

Port/Channel Map: Local ☐ ☐ ☐ ☐ ☐ ☐ Remote ☐ ☐ ☐ ☐ ☐ ☐

- ***Operating Rate***

Fallback-Outbound: ☐ 19.2 ☐ 16.8 ☐ 14.4 ☐ 12.0
☐ 9.6 ☐ 7.2 ☐ 4.8 ☐ 2.4

Fallback-Inbound: ☐ 9.6 MIR ☐ 9.6 ☐ 7.2 MIR ☐ 7.2
☐ 4.8 MIR ☐ 4.8 ☐ 2.4

- **Timing**

☐ Local — Internal ☐ Loopback ☐ Port 1 Port __
☐ Remote — Internal ☐ Loopback ☐ Port 1 Port __

Modem Straps. For the following strap selections, enter 0 or 1 in the blank provided between the two choices. Note that four digits cover transmit level.

- ***Strap 01***

0 Condition	**Enter 0 or 1**	**1 Condition**
Leased line transmit level not selectable	____	Leased line transit level selectable
CH fallback disabled	____	CH fallback enabled
Fallback 1 rate with CH (e.g., 9.6 to 7.2 kbps)	____	Fallback 2 rates with CH (e.g., 9.6 to 4.8 kbps)
Normal carrier control based on operating mode	____	Forced controlled carrier

Transmit level set at ________

■ **Note:** Transmit level is factory preset for international units.

- *Strap 02*

0 Condition	Enter 0 or 1	1 Condition
Normal equalization recovery based on operating mode	____	Equalization recovery disabled
Short Round Robin blind time selected (1 second) (2.6 seconds in V.33 operating mode)	____	Long Round Robin blind time selected (2 seconds) (4 seconds in V.33 operating mode)
High UI error rate threshold (10^{-3})*	____	Low UI error rate threshold (10^{-4})*
Short UI threshold time (2 sec) (4 seconds in V.33 operating mode)	____	Long UI threshold (7 sec) (9 seconds in V.33 operating mode)
141 disabled	____	141 enabled
Leased line carrier detect threshold set at −26 to −31 dBm	____	Leased line carrier detect threshold set at −33 to −38 dBm
Selects scramblers/descramblers compatible with 2620/2640 CS48FP modulation modes	____	Selects scramblers/descramblers compatible with CS48FP modems
Reserved	____	Reserved

*If in PP ARS or ARS 19.2 mode, this strap has a different function:

8 minutes, fall-forward time; 2 minutes, fallback time; 3 UIs to fall back	____	15 minutes, fall-forward time; 3 minutes, fallback time; 6 UIs to fall back

Port Configuration

Data Clock. Fill in the blanks in the following table with Y for Yes or N for No. Pt = Port.

Data Clock	*Pt 1*	*Pt 2*	*Pt 3*	*Pt 4*	*Pt 5*	*Pt 6*	*Pt 7*	*Pt 8*
SYNC INT	___	___	___	___	___	___	___	___
SYNC EXT	___	___	___	___	___	___	___	___
ISOC	___	___	___	___	___	___	___	___
ASYNC 6D	___	___	___	___	___	___	___	___
ASYNC 7D	___	___	___	___	___	___	___	___
ASYNC 8D	___	___	___	___	___	___	___	___
ASYNC 9D	___	___	___	___	___	___	___	___

Straps 03, 05, 07, 09, 11, and 13. Fill in the blanks in the following table with Y for Yes or N for No. Pt = Port; L = Local; R = Remote.

Parameter	*Pt 1*		*Pt 2*		*Pt 3*		*Pt 4*		*Pt 5*		*Pt 6*		*Pt 7*		*Pt 8*	
	L	*R*	*L*	*R*	*L*	*R*	*L*	*R*	*L*	*R*	*L*	*R*	*L*	*R*	*L*	*R*
DCD Always On	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
RTS Always On	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
CTS Follows RTS	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
DSR Always On	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
RTS Signaling Enabled	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
DCD Signaling Enabled	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
DTR Signaling Enabled	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
DSR Signaling Enabled	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___

Straps 04, 06, 08, 10, 12, and 14. Fill in the blanks in the following table with Y for Yes or N for No. Refer to page 2-38 for possible RTS/CTS delays. Pt = Port; L = Local; R = Remote.

Parameter	*Pt 1*		*Pt 2*		*Pt 3*		*Pt 4*		*Pt 5*		*Pt 6*		*Pt 7*		*Pt 8*	
	L	*R*	*L*	*R*	*L*	*R*	*L*	*R*	*L*	*R*	*L*	*R*	*L*	*R*	*L*	*R*
RTS/CTS Delay	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
Circuit 140 Enabled	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
RLB Detect Enabled	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___

Network Control Configuration

Address. Fill in the following blanks.

Location: ________ ________ ________ ________ ________ ________ ________
Serial Number: ________ ________ ________ ________ ________ ________ ________
NC Address: ________ ________ ________ ________ ________ ________ ________

FSK Rate: ☐ 75 bps ☐ 110 bps ☐ 150 bps
DCP Rate: ☐ 75 bps ☐ 110 bps ☐ 150 bps

Strap 21. For the following strap selections, enter 0 or 1 in the blank provided between the two choices.

0 Condition	Enter 0 or 1	1 Condition
FSK Switched Carrier	____	FSK Constant Carrier
FSK controlled by tree selection of FSK rate	____	FSK rate forced to 75 bps
FSK Carrier Detect level set at −41 to −50 dBm	____	FSK Carrier Detect level set at −31 to −41 dBm
FSK Carrier Detect response time set at 25 ms	____	Carrier Detect response time set at 50 ms
Wired MSU strap used at slave and master modems when only one modem is connected to the network control channel	____	Wired MSU strap used at master modems when more than one modem is connected to the same network control channel
Control Channel Carrier Detect normal	____	Control Channel Carrier Detect always On at DCPs

DDR Option Configuration

DDR Strap 22. For the following strap selections, enter 0 or 1 in the blank provided between the two choices.

0 Condition	Enter 0 or 1	1 Condition
(a) Tone Dial	____	(a) Pulse Dial
(b) Blind Dial disabled	____	(b) Blind Dial enabled
(c) Validity Check enabled	____	(c) Validity Check disabled
(d) Auto Answer enabled	____	(d) Auto Answer disabled
(e) FSK Carrier Detect Level = −42 dBm On/−51 dBm Off	____	(e) FSK Carrier Detect Threshold = −51 dBm On/−60 dBm Off
(f) Reserved		(f) Reserved
(g) Carrier Detect Threshold = −43 dBm On/−48 dBm Off	____	(g) Carrier Detect Threshold = −36 dBm On/−41 dBm Off

Enhanced DDR Strap 22. For the following strap selections, enter 0 or 1 in the blank provided between the two choices.

0 Condition	Enter 0 or 1	1 Condition
(a) Tone Dial	____	(a) Pulse Dial
(b) Blind Dial disabled	____	(b) Blind Dial enabled
(c) Validity Check enabled	____	(c) Reverse Dial enabled
(d) Auto Answer enabled	____	(d) Auto Answer disabled
(e) FSK Carrier Detect Level = −42 dBm On/−51 dBm Off	____	(e) FSK Carrier Detect Threshold = −51 dBm On/−60 dBm Off
(f) Inactivity Disconnect disabled		(f) Inactivity Disconnect enabled
(g) Carrier Detect Threshold = −43 dBm On/−48 dBm Off	____	(g) Carrier Detect Threshold = −36 dBm On/−41 dBm Off

Enhanced DDR Strap 23. For the following strap selections, enter 0 or 1 in the blank provided between the two choices.

0 Condition	Enter 0 or 1	1 Condition
(a) Automatic DDR disabled	____	(a) Automatic DDR enabled
(b) DTR not used	____	(b) DDR conditional on DTR
(c) DTR not used	____	(c) DTR initiates dial
(f) Terminate with test—Nondisruptive	____	(f) Terminate with test—Disruptive

(d) and (e) 00 = No leased line check
01 = Check of LL every hour
10 = Check of LL every 2 hours
11 = Check of LL every 4 hours

Enter Condition: ____

Telephone Numbers. Fill in the telephone numbers in the spaces provided.

Local Modem Transmit Telephone Number: ________________________________

Local Modem Receive Telephone Number: ________________________________

Remote Modem Transmit Telephone Number: ________________________________

Remote Modem Receive Telephone Number: ________________________________

Chapter 3
Point-to-Point

Contents

General 3-2
Point-To-Point Applications 3-2
  CQMS in Point-to-Point Applications 3-6
  Point-to-Point Modes with Trellis-Coded Modulation (TCM) 3-8
  Point-to-Point Codex-Improved Mode (PP CI) 3-10
  V.33 Point-to-Point Mode 3-10
  V.29 Point-to-Point Mode 3-10
  V.27 *bis* Point-to-Point Mode 3-10
  Multiplexing Feature 3-10
  Modem Sharing Feature 3-11
  Control Signaling 3-17
  Async-to-Sync Conversion 3-19
  Point-to-Point Loopbacks 3-19
  Terminal Loopback 3-19
  Digital Loopback 3-19
  Modem Check (Analog Loopback) 3-19
  Audio Loopback 3-19
Point-to-Point Tests 3-21
  Poll Test 3-21
  BER Test 3-21
  Self Test 3-21
  Test Tone 3-21
  Special Control Signal Handling in Loopbacks and Tests 3-22
  Applications 3-23
    2680 Modem ARS Advantage 3-23
    2660 Modem MSU Advantage 3-24

GENERAL

The Codex 2680, operating at 19.2 kbps, sets the standard for performance and reliability in very high-speed modems for point-to-point applications in independent and network configurations. Superior design in the Codex 2680 offers the enhanced 64-State 8-Dimension Trellis-Coded Modulation (64 × 8 TCM), a form of error-correction coding that interweaves, or trellises, bits of data, allowing the 2680 receiver to interpret transmitted data with the most accuracy. This improved TCM demonstrates a high tolerance for unpredictable or disruptive line conditions.

The Codex 2680 incorporates Codex's Adaptive Rate System (ARS). When selected, ARS enables the 2680 to automatically adapt its main channel rate from 12.0 to 19.2 kbps (in 2400 bps increments) in response to changing line quality. ARS can be used in most host-to-host statistically multiplexed and buffered multiplexed applications. The Codex 2680 permits effective integration of optional 4- or 6-channel multiplexers as well as the integral Dual Dial Restoral (DDR) and reserves future expansion capabilities through the XL options in the 2600 Series.

The Codex 2660 uses the Codex-pioneered Trellis-Coded Modulation (TCM) technique. Using TCM, the 2660's performance at 14.4 kbps approaches that of a 9600 V.29 modem. The Codex 2660 also provides the integral Modem Sharing Unit (MSU), which offers optimum results within a polled environment and gives increased efficiency in line utilization.

The 2660 introduced Codex's Adaptive Rate System (ARS). ARS provides the 2660 with the ability to automatically adapt its main channel data rate from 9.6 to 16.8 kbps. The automatic adjustment eliminates the inefficiency of manually reconfiguring main channel rates, thereby providing optimized throughput under all line conditions.

The 2666 modem utilizes all the features of the 2660 modem including the operating modes and MSU function. In applications where conformity to CCITT operating modes is required, the Codex 2666 Modem also provides V.33 operation at 14.4 kbps as a primary data rate with fallback to 12.0. The V.33 Trellis-Coded Modulation (TCM) scheme offers high performance and reliability in compatible CCITT applications.

Four- and six-channel multiplexing options with built-in MSU (Modem Sharing Unit), async/sync converter, and control signaling features are available for the point-to-point 2640, 2660 and 2666. These built-in features allow the multiplexing options to be used in many more and varied applications.

Table 3-1 gives product features specific to each modem type. Table 3-2 lists the operating modes available in point-to-point configurations. Table 3-3 and 3-4 offer summary information on product configurations.

Table 3-1.
2600 Series Product Features

Feature	*Model 2680*	*Model 2660*	*Model 2666*	*Model 2640 V.29, PP CI and 2620 PP V.27* **bis**
Control Panel (with remote capability)	Yes	Yes	Yes	Yes
Network Management Systems	DNCS 200/300 Codex 4850/4860	DNCS 200/300 Codex 4850/4860	DNCS 200/300 Codex 4850/4860	DNCS 200/300 Codex 4850/4860
Network Management System Control Channel	Embedded 110 bps	FSK 75/110 bps	FSK 75/110 bps	FSK 75/110 bps
Circuit Quality Monitoring System (CQMS)	Yes	Yes	Yes	Yes
Multipoint Signal Quality Binning (MSQB)	No	No	N/A	N/A
Mixed Inbound Rates	No	No	N/A	N/A
Adaptive Rate	Yes (ARS 19.2 Mode: 12.0 – 19.2)	Yes (PP ARS Mode: 9.6 – 16.8)	No	No (2640) Yes (2620)
Eye Pattern Generator (Standard)	Yes	Yes	Yes	Yes
Power-Up Self Test	Yes	Yes	Yes	Yes
Data Handling	Sync Async 6 to 9 bits Block Isoc	Sync Async 6 to 9 bits Block Isoc	Sync Async 6 to 9 bits Block Isoc	Sync Async 6 to 9 bits Block Isoc
CCITT V.54 Circuits 140/141/142	Yes	Yes	Yes	Yes
RTS Control Signaling	Yes	Yes	Yes	Yes
DTR Control Signaling	Yes	Yes	Yes	Yes
Dual Channel Buffered TDM	Standard	No	No	No

(continued on next page)

Table 3-1 (continued).
2600 Series Product Features

Feature	*Model 2680*	*Model 2660*	*Model 2666*	*Model 2640 V.29, PP CI and 2620 PP V.27 bis*
Multiport (4) Option				
4 DTE Ports	Yes	Yes	Yes	Yes
4-Port Buffered TDM*	Yes	Yes	Yes	Yes
2- to 4-Port MSU	No (use 2660)	Yes (all modes)	Yes (all modes)	Yes
User-Configurable TDM	Yes	Yes	Yes	Yes
Compatible Mux Configurations	None	V.29	None	V.29
Multiport (6) Option				
6 DTE Ports	Yes	N/A	Yes	N/A (2620) Yes (2640)
6-Port Buffered TDM*	Yes	Yes	N/A	N/A (2620) Yes (2640)
2- to 6-Port MSU	No (use 2660)	Yes (all modes)	N/A	N/A (2620) Yes (2640)
User Configurable TDM	Yes	Yes	N/A	N/A (2620) Yes (2640)
Compatible Mux Configurations	None	V.29	N/A	N/A (2620) V.29 (2640)
Audio Features				
Domestic 4-Wire Leased	3002 D1	3002 D1	3002	3002
International 4-Wire Leased	M1020	M1020	M1040	M1040
Dual Dial Restoral Option				
FCC Part 68 Registered	Yes	Yes	Yes	Yes
Manual or Auto Answer	Yes	Yes	Yes	Yes
Automatic Dialing (DTMF or Universal Pulse Dialing)	Yes	Yes	Yes	Yes
Power Fail Alarm	No	Yes	Yes	Yes

---

* See Tables 3-6, 3-7, and 3-8 for multiplexer configurations.

Table 3-2.
2600 Series Operating Modes

Operating Mode	*Data Rate (kbps)*	*Transmit Carrier Mode*	*Telephone Line Requirement*	*Training Time (ms)*	*Equalization Recovery Method**	*Unique Feature*
PP 19.2	19.2 16.8 14.4 12.0	Constant	3002 D1 M1020	1000 750 500 250	Round Robin (1 to 2 sec)	64-state 8-dimensional Trellis-Coded Modulation (64 × 8 TCM)
ARS 19.2	19.2 16.8 14.4 12.0	Constant	3002 D1 M1020	1000 750 500 250	Round Robin (1 to 2 sec)	Adaptive Rate System (ARS)
PP TCM	16.8 14.4 12.0 9.6	Constant	3002 D1 M1020	492 392 292 192	Round Robin (1 to 2 sec)	8-state 2-dimensional Trellis-Coded Modulation (TCM)
PP ARS	16.8 14.4 12.0 9.6	Constant	3002 D1 M1020	492 392 292 192	Round Robin (1 to 2 sec)	Adaptive Rate System (ARS)
PP CI	9.6 7.2 4.8	Constant	3002 M1040	253	Round Robin (1 to 2 sec)	Improved Signal Constellation (compared to V.29)
V.33	14.4 12.0	Constant	3002 D1 M1020	1393 1393	Round Robin (2.6 to 4)	End-to-end compatible with any CCITT V.33 modem.
V.29	9.6 7.2 4.8	Constant	3002 M1040	253	Round Robin (1 to 2 sec)	End-to-end compatible with any CCITT V.29 modem (without network control)
V.27 (PP)	4.8 2.4	Controlled	3002 M1040	708 943	Round Robin (1 to 2 sec)	End-to-end compatible with any CCITT V.27 *bis* (without network control)

*Approximate recovery time.

Table 3-3.
2600 Series Product Configurations

Operating Mode	*2680*	*2660*	*2666*	*2640*	*2620*
PP 19.2	●				
ARS 19.2 (19.2, 16.8, 14.4, 12.0 kbps)	●				
PP ARS (16.8, 14.4, 12.0, 9.6 kbps)		●	●		
PP TCM (16.8, 14.4, 12.0, 9.6 kbps)		●	●		
V.33 (14.4, 12.0)			●		
V.29 (9.6, 7.2, 4.8 kbps)		●	●	●	
PP CI (9.6, 7.2, 4.8 kbps)				●	●
V.27 *bis* Point-to-Point (4.8, 2.4 kbps)					●

■ **Note:** The 2680 and 2660 are not compatible with each other.

Table 3-4.
Recommended Operating Modes

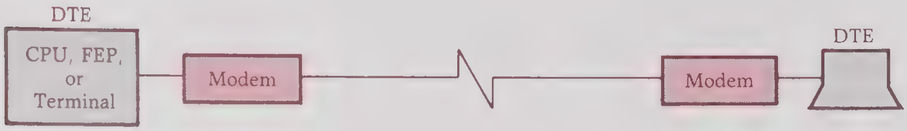
Application	*Recommended Mode*
Point-to-Point	
19.2 kbps	ARS 19.2 (Adaptive Rate System determines optimum performance supported by line.)
16.8 kbps	PP ARS (Adaptive Rate System determines optimum performance supported by line.)
14.4 kbps	PP TCM; V.33
12.0 kbps	V.33
9.6 kbps	PP CI
4.8 kbps	PP CI
CCITT V.29 Compatibility	V.29 (If compatibility not required, PP CI mode is recommended for 9.6 kbps point-to-point operation.)
CCITT V.27 *bis* Compatibility	V.27

POINT-TO-POINT APPLICATIONS

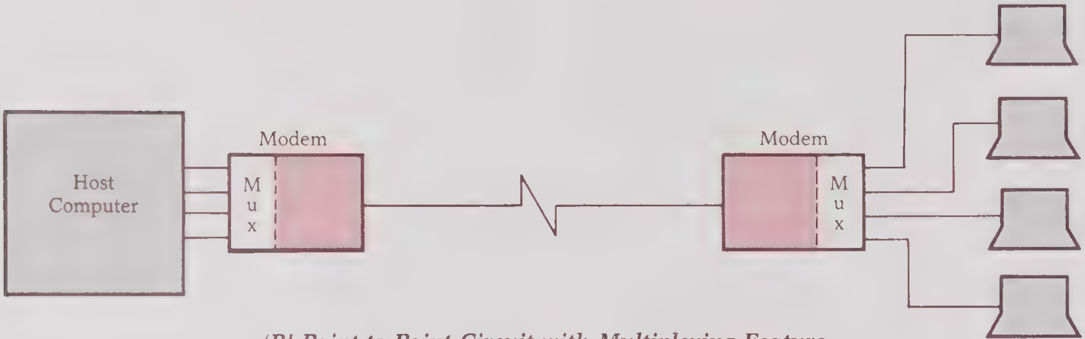
Point-to-point circuits are generally operated with constant carrier in both directions between the local and remote modems. Figure 3-1(A) illustrates a basic point-to-point circuit (single port at both ends); Figure 3-1(B) illustrates a point-to-point circuit with a multiplexing feature (multiple transparent ports at both ends); and Figure 3-1(C) illustrates a point-to-point circuit with a modem sharing feature (single port at host/FEP with multiple remote ports contending). TDM multiplexing is available in point-to-point networks only. In MSU applications, only one modem needs the multiplexing option.

In point-to-point applications, both modems train each other at power-on and usually will not train again unless the telephone line degrades for an extended period of time (normally one error in 10^4 bits for 4 seconds) or if the modem connection to the line is in some way disturbed (for example, through a test). In these cases, the modem will automatically detect and initiate Round Robin. This is known as Unattended Initiate (UI). The UI error rate and length of time are user-configurable except in the PP ARS mode.

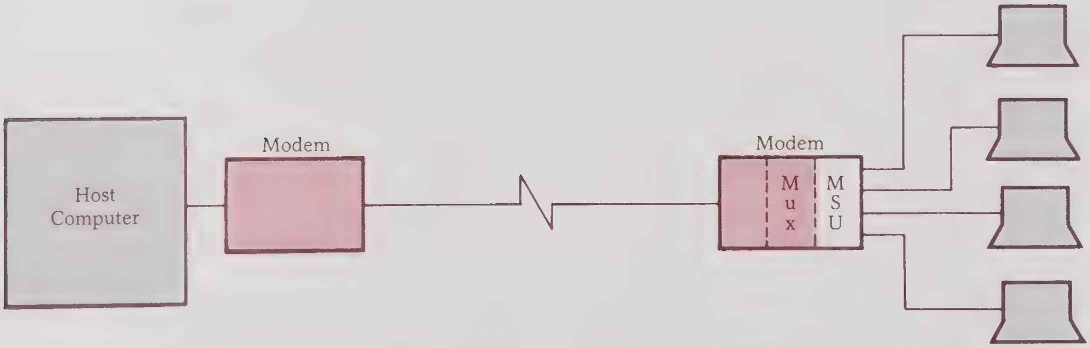
If the local modem sends out a training sequence (as on power-up or if the data error rate is excessive for a period of time), the remote modem will detect the reception of the training sequence and send a train back to the first modem. This round trip of training is referred to as Round Robin (RR) training. It ensures that both receivers are synchronized and that each receiver equalizer is properly adjusted.



(A) Basic Point-to-Point Circuit



(B) Point-to-Point Circuit with Multiplexing Feature



(C) Point-to-Point Circuit with Mux Option Configured as a Modem Sharing Unit

Figure 3-1. Point-to-Point System

After the local transmitter sends the training sequence, it locks out any request from the local receiver for a training sequence transmission for a period of time called the Blind Time. The length of the Blind Time is normally 1 second but is user-configurable to 2 seconds. (In the V.33 operating mode, the Blind Time ranges from 2.6 to 4 seconds.) The longer Blind Time is usually needed for satellite links. The Blind Time must be long enough to complete the round trip of the training sequence. If the Blind Time is shorter than the total path delay, the local receiver will detect the return training sequence after the Blind Time expires and will then send another training sequence to reply to an apparent training request from the remote modem. The modems will continuously retrain with Round Robin and never go to the data transmission mode.

You should always enable Round Robin training for point-to-point operation. You would disable it only for troubleshooting telephone line problems or for special network configurations.

CQMS in Point-to-Point Applications

CQMS (Circuit Quality Monitoring System) provides continuous noninterruptive quantitative monitoring of line conditions. It estimates the line degradations by averaging the differences in magnitude and phase of the equalized received signal from the values that would result from an undistorted channel. These averages are compared to thresholds that are downline loaded from the Network Management System, and if the thresholds are exceeded, the modem sets the appropriate alarms. CQMS averages can be computed only after a long-term examination of the received signal. The following parameters can be monitored and are displayed on the Control Panel: *Signal-to-Noise Ratio, Phase Hits, Gain Hits, Impulse Hits, Receive Level, and Error Probability* (see the CQMS✳ Category section in Chapter 2). Additional parameters that can be monitored but do *not* appear on display are: Phase Jitter, Dropouts, Marginal Polls, Transmit Level, Retrains, Harmonic Distortion, Third Harmonic Distortion, and Frequency Offset.

Point-to-Point Modes with Trellis-Coded Modulation (TCM)

Operating Modes. The following sections discuss the features that apply to the various operating modes available in point-to-point modems and their applications. When you select an operating mode via the Control Panel, the modem automatically sets the appropriate parameters for that application. Because of these automatic parameter defaults, you need not be concerned with the detailed strapping in a common point-to-point application. For example, if you select the PP TCM mode, the modem automatically sets the transmit and receive rates at 14.4 kbps, operates in constant carrier, and enables Round Robin (RR) training for equalization. For all operating modes, the modem automatically selects 0 dBm transmit level, selects low UI error rate threshold time period, sets leased line carrier detect threshold at −26 to −31 dBm, and so on. On international models, the transmit levels for the 2666 have been factory preset to 0 dBm, −6 dBm, or −13 dBm, according to the appropriate Postal Telephone and Telegraph (PTT) requirements.

You have the option to override these default parameters, if necessary, and reconfigure local and remote modems to your unique application through software strapping via Network Management Systems or the Control Panel.

Five point-to-point modes use Trellis-Coded Modulation: PP 19.2 (64 × 8 TCM), ARS 19.2, PP TCM, PP ARS, and V.33. The PP 19.2 and ARS 19.2 modes allow operation at 19.2, 16.8, 14.4, and 12.0 kbps over D1 leased lines (no C-conditioning required). PP TCM and PP ARS allow operation at 14.4, 12.0 and 9.6 kbps over D1 leased lines, and also allow up to 16.8 kbps on lines that are better than the minimum D1 specifications. The V.33 mode allows operation at 14.4 and 12.0 kbps over M1020 lines. These modes are the recommended modes of operation for the Codex 2680, 2660, and 2666, and the PP ARS mode is most useful in the application explained in the paragraph entitled Adaptive Rate System on the next page.

These modes employ a relatively long training sequence, which allows the modem to learn all significant channel characteristics. The length of the training sequence is dependent on the transmission rate chosen. Round Robin retraining is supported; however, these modes recover easily from dropouts of 10 seconds or less without the need for a retrain by retaining critical information on circuit equalization during these short line outages.

Performance. A Trellis-Coded Modulation method is used to improve the Block Error Rate (BLER) performance of the modem at greater than 9600 bps. It is applied to data at the transmitter and is used to reduce decision errors at the receiver. In the 2660 at 14.4 kbps, for example, instead of using the common 64-point signal pattern, the data is transmitted using a 128-point signal constellation, which includes redundant information about the overall sequence of data being transmitted. The receiver can detect errors in sequences rather than just in individual bits and can, therefore, correct in sequences rather than in individual bits. This error correction allows for better performance with a lower BLER than would be possible without coding. You can, therefore, operate in a noisier environment and still get the same performance.

Line Quality Feature. The Line Quality feature, available in 2680 Modems, balances error performance and throughput delay to maximize effective modem data throughput, given operating conditions. Effective data throughput in a network depends on a number of factors including: system loading, application, modem speed, application protocol, line quality, and throughput delay. Although modems may often play a relatively small role in determining a network's overall data throughput, this feature allows you to configure the modem for maximum throughput and minimum delay given line conditions and application requirements.

High speed modems operating over high quality lines yield the greatest data throughput. As modem speed increases, and line quality decreases, modems are more likely to make errors. If allowed to pass through the modem uncorrected, these errors result in time-consuming data retransmissions. Hence, most high speed modems are designed with error correction schemes. These complex coding schemes decrease the number of errors and retransmissions. They also increase throughput delay through the modem. Thus, there is a tradeoff between error performance and throughput delay.

The Codex 2680 Modem is initially configured to use Codex's patented 64-state, 8-dimensional trellis coded modulation (TCM). This complex coding scheme (LQ1), enables the 2680 to perform 99.5% error free on over 90% of D1 conditioned lines. It is the most powerful coding scheme available, and yields the best error performance. The Codex 2680 also includes two additional selections, LQ2 and LQ3, with less complex error correction, for use on better quality lines. Using these selections, greater data throughput can be achieved on good lines, since the less complex trellis-coded scheme contributes less throughput delay.

You can select the Line Quality mode from the MODEM tree at the LQ MODE: parameter. After you select Line Quality mode, the selected mode will flash.

These are the three configuration options:

- ***LQ=1 (highest error performance, standard throughput delay).*** LQ1 is the initial selection and is recommended for operation over the widest range of D1-conditioned lines or for noisy or disruptive lines. LQ1 offers the highest error performance and highest throughput delay because of its complex multistate, multidimensional coding scheme.
- ***LQ=2 (high error performance, low throughput delay).*** With only moderate delay, LQ2 yields significantly higher throughput than LQ1 over improved lines.
- ***LQ=3 (lower error performance, very low throughput delay).*** When lines are clean and have little noise, LQ3 provides the highest data throughput.

The following factors should be considered before selecting an LQ setting: protocol, line conditions, multiplexing, and type of application.

Protocol Considerations

- ***Full-Duplex Protocols.*** Full-duplex protocols transmit data in both directions simultaneously. In other protocols, the transmitting modem typically sends out several frames at a time, waits for an acknowledgement from the receiving modem, and only then sends out additional data frames. This delay occurs every time the line is "turned around." The system response time is directly affected by this time spent waiting for an acknowledgment. The modem's throughput delay is one of the contributing factors to the waiting period.

  In full-duplex protocol environments, modem throughput delay has no effect on data throughput because transmission continues without waiting for an acknowledgment. Thus, modems used in full-duplex environments should always be configured in LQ1, the highest error performance setting. Applications using other protocols will benefit from higher LQ settings, with less throughput delay, if line conditions permit.

Note that some protocols, normally considered to be full-duplex protocols, can be configured for less than full-duplex operation. Also, some applications override the protocol configuration and check for acknowledgements every few frames. Experimentation may demonstrate some benefit from LQ2 or LQ3.

As discussed above, line quality is the major factor in determining which LQ setting to select. Except for full-duplex environments, modems should be configured for the highest LQ setting at which they can operate reliably.

Other Considerations

You will see the greatest benefit from the Line Quality feature in half-duplex batch environments operating at 19.2 kbps. Delays inherent in interactive or statistically multiplexed environments often exceed modem throughput delay and may mask the additional throughput achieved with this feature. When multiple applications are time division multiplexed, each application derives only a fraction of the benefit provided by this feature.

Compatibility

As shown in the table below, if both modems are configured for LQ1, they will run in LQ1. If one modem is configured to LQ1 and the other is configured to either LQ2 or LQ3, the modems operate at LQ1. A 2680 without the LQ feature runs automatically in LQ1.

MODEM tree		*GENERAL tree*	
Configuration		*Status*	
Modem 1	*Modem 2*	*Modem 1*	*Modem 2*
LQ1	LQ1	LQ1	LQ1
LQ1	LQ2	LQ1	LQ1
LQ1	LQ3	LQ1	LQ1
LQ2	LQ2	LQ2	LQ2
LQ2	LQ3	LQ2	LQ3
LQ3	LQ2	LQ3	LQ2
LQ3	LQ3	LQ3	LQ3

Modem synchronization takes place every time there is a train between the two modems. Each modem encodes its Line Quality mode configuration into training information. The 2680 modems use the Line Quality mode information received during the training sequence and decide which mode to select. Synchronization can be achieved with any combination of Line Quality mode configurations.

> ***IMPORTANT***
>
> Compatible mode selection relies on training information which the Round Robin strap controls. Do not disable Round Robin (Strap 2).

Once the modems have selected a compatible mode, any retrain verifies the current status. There are no extra trains after a compatible Line Quality mode has been achieved.

Status Display

Since the configured Line Quality mode and the actual Line Quality mode may be different, you need to check the status display to monitor the actual Line Quality mode of each modem.

The LQ= XXX will read:

LQ= 1
LQ= 2
LQ= 3
or LQ= %%%%

If the configured Line Quality mode and the Line Quality mode status are not the same, you have not consistently configured both modems on the segment. In this case, the modems will select compatible modes. If both modems are set to LQ1, they will show LQ1 as their status. If Modem 1 and Modem 2 are configured at LQ2/LQ3 respectively, that is what they will show as their status.

Occasionally you may see LQ=%%%% on the display window of your modem. It indicates that the two modems have not yet established compatible Line Quality modes. "%%%%" (no Line Quality mode active) is a transient state only.

In the 2680, the Adaptive Rate system is supported in all three Line Quality modes. Line Quality and Adaptive Rate are not substitutes for each other; they are used for different purposes. To maximize efficiency, use the Line Quality feature and Adaptive Rate System together. The Adaptive Rate System is intended for unattended adjustment to occasional changes in line conditions. It is an automatic adjustment that allows the modem to keep transmitting data at the maximum speed possible given transmit line conditions.

Adaptive Rate System. The PP ARS and ARS 19.2 modes support an Adaptive Rate System. This system allows the pair of modems in a point-to-point application to select the rate from the best operation on a specific line, based on the current quality of the line as determined by the Circuit Quality Monitoring System (CQMS) within the modem. If line conditions improve, the modems' rates increase; if line conditions deteriorate, the modems will operate at a lower rate until conditions improve. This ability is particularly valuable in host-to-host links and internodal (stat mux) links, where optimum throughput is a necessity. It is also valuable in applications using the multiplexer option where at least one port supports synchronous devices (such as terminals or printers) that tolerate rate changes and use the modem-provided data timing.

Either modem can force a fallback: If UI and Round Robin cannot equalize the modem after several attempts, then the modem falls back to the next lower rate (that is, from 14.4 kbps to 12.0 kbps).

For operation to fall forward, both modems must agree. A modem decides to fall forward if the signal quality is sufficient to run at the next higher rate. However, *both modems must agree before this operation is implemented.* The two modems communicate with each other via the Round Robin sequence before falling back or falling forward. Fallback and fall forward are implemented in 2.4 kbps increments (that is, fallback from 19.2 kbps to 16.8 kbps to 14.4 kbps, and so on).

You can use the third bit of modem strap 2 to select the amount of "wait time" before fallback or fall forward is initiated. Table 3-5 defines the possible selections. In all other operating modes, this bit serves a different function (UI error rate threshold). However, in the PP ARS and ARS 19.2 modes, the UI threshold is not configurable. ■ **Note:** The Round Robin sequence is data-disruptive when falling forward or falling back. Therefore, if the third bit of modem strap 2 is set at 0, the modem will wait 8 minutes before it falls forward and will require 3 UI's within a 2-minute time period to fall back. If the bit is set at 1, then the modem will wait 15 minutes to fall forward and will require 6 UI's within a 3-minute time period to fall back.

The modem may occasionally require more than one RR sequence in the event of a line disturbance that causes errors during retrain. During normal operation, fall forward/fallback will require only one RR.

The Adaptive Rate System has one requirement: *The DTEs connected to the ports that change must be synchronous and accept clock from the modems.* When this mode is used with a multiplexer, channel rate changes on individual port rates are altered as if fallback/fall forward were manually initiated.

Table 3-5.
Adaptive Rate Selections

Parameter	*0 Setting*	*1 Setting*
Fall Forward Time	8 minutes	15 minutes
Fallback Time	2 minutes	3 minutes
Fallback No. of UI's	3 UI's	6 UI's

Point-to-Point Codex-Improved Mode (PP CI)

The Point-to-Point Codex-Improved mode (PP CI) allows operation at 9.6, 7.2, and 4.8 kbps over unconditioned lines; with its 253 ms training sequence, this mode is best used for constant carrier applications. The PP CI mode is available only in the 2640 and 2620 and, within these products, it is the best mode to be used in point-to-point constant carrier applications. In the 2620 model, the PP CI mode is limited to 4.8 kbps. Also, in the 2620, the PP CI mode is the only multiplexing mode.

As in the other operating modes, the PP CI mode has a training sequence that allows the modem to learn all significant channel characteristics. The Round Robin technique is used when retraining is necessary. This mode recovers easily from short dropouts of 10 seconds or less without the need for a retrain by retaining critical information on circuit equalization during these short line outages.

Performance. The PP CI mode uses a signal constellation that is similar to and better than V.29, providing improved performance against noise and a more robust phase lock. Signal-to-Noise Ratio performance over an unconditioned 3002 private line is approximately 1.3 dB better than that found in V.29 modems over the same line.

V.33 Point-to-Point Mode

The 2666 modem utilizes all the features of the 2660 modem including the operating modes and MSU function. In applications where conformity to CCITT operating modes is required, the Codex 2666 Modem also provides V.33 operation at 14.4 kbps as a primary data rate with fallback to 12.0. The V.33 Trellis-Coded Modulation (TCM) scheme offers high performance and reliability in compatible CCITT applications.

V.29 Point-to-Point Mode

The V.29 Point-to-Point mode is available in the 2640, 2660 and 2666 modems and allows operation at 9.6, 7.2, and 4.8 kbps over 4-wire unconditioned leased lines; it should be used when CCITT V.29 compatibility is required. If V.29 compatibility is not required, the PP CI mode is the recommended mode of operation for a 9.6 kbps point-to-point application. V.29 does not employ the Trellis-Coded Modulation technique.

Except where stated, this mode performs exactly as the PP CI mode described in the previous paragraph.

V.27 *bis* Point-to-Point Mode

The Point-to-Point V.27 *bis* mode allows operation at 4.8 and 2.4 kbps over unconditioned lines. Using the CCITT V.27-specified "long train" (708 ms at 4.8 kbps and 943 ms at 2.4 kbps), this mode is best used for constant carrier applications. The V.27 *bis* mode is available only in the 2620 and, within this product, it is recommended for use when international V.27 *bis* compatibility is required. The multiplexing option cannot be used with this mode, but the MSU function can be used for "digital" multipoint applications. This mode can be used in switched carrier applications, but because the modem is interfaced for 4-wire lines only (not 2-wire lines), switched carrier should never be required.

The V.27 *bis* "long train" allows the modem to learn all significant channel characteristics. The Train On Data technique is used when retraining is necessary. This mode recovers easily from short dropouts of 10 seconds or less without the need for a retrain by retaining critical information on circuit equalization during these short line outages.

Multiplexing Feature

The Time Division Multiplexing (TDM) function divides the main channel into two or more independent multiplexed channels. It is operable only in point-to-point configurations and cannot be used with CS48FP or V.27 *bis* operating modes. (The MSU feature of the multiplexer can also be used in multipoint configurations.) The multiport DTE options provide a preconfigured set of up to 15 standard mux configurations based on the number of ports. See Table 3-6 (4-port), Table 3-7 (6-port), and Table 3-8 (for the 19.2 kbps 2680 Modem) for these configurations. These tables illustrate the channel rates as a function of main channel rate and multiplexer mode, and also illustrate the fallback mux configurations that are implemented when a main channel fallback rate is selected.

The CCITT recommendation for the V.33 mode specifies multiplexer configurations and a modulation different from the standard 2600 mux configurations. When you operate the modem in the V.33 mode only, the mux configurations will be those shown in Table 3-9 (for the 2666 Modem). V.33 defines aggregate channel rates of 14.4 and 12.0 kbps only.

For the V.33 mode, fallback functions differently than for other modes. That is, when fallback occurs from V.33 to V.29 within the same mux mode, the number of channels that are available may change. For example, if you have the modem in the V.33 operating mode and use mux mode 5, you are operating with a 2-channel mux (see Table 3-9). If you change the operating mode to V.29, you are then using a standard 4-channel mux (see Table 3-6). To get the 2-channel V.33 mux again, you must select either mux mode 2 or mux mode 3 (see Table 3-9).

Table 3-6 highlights mux modes 1 to 5, which are 4.8 to 9.6 kbps main channel rates. These are the V.29-defined mux configurations labeled [1] through [10]. When the equipment is operating in a V.29 modulation mode, you must pick the main channel rate and desired mux mode that will give the desired V.29-defined mux mode.

The user-configurable channel speeds that can be selected are 1.2 kbps or integer multiples of 2.4 kbps, totaling up to the modem's main channel rate. Channel speed selection at 1.2 kbps must be limited to one of the following:

- Select pairs of 1.2 kbps channels.
- Operate an odd number of channels at 1.2 kbps, and leave 1.2 kbps of the main channel unused.

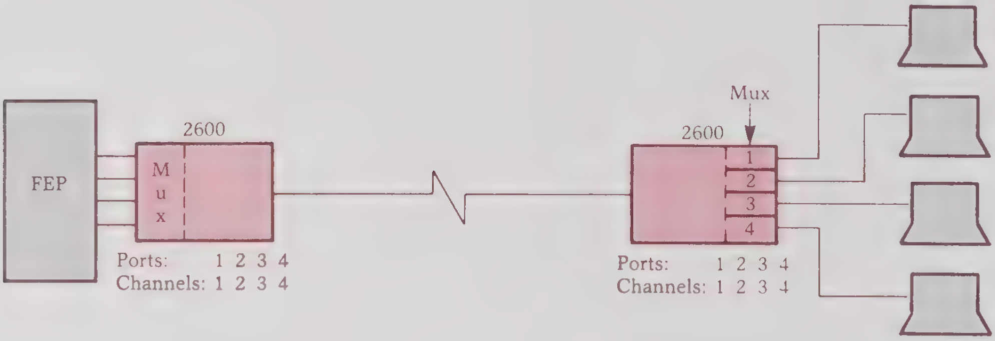
A Time Division Multiplexer for a 1200 bps channel on a 2400 baud modem sends one bit every other baud on that channel. In order to synchronize the multiplexer, a retrain is always required when any change is made to or from a mux configuration that includes a 1200 bps channel. This retrain can be accomplished in several ways:

1) Send a retrain command from Network Control.
2) Go into "Modem Check" and then "No Loop."
3) Power modem off and on.

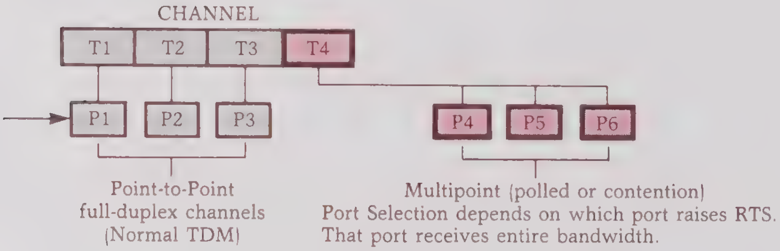
Modem Sharing Feature

A built-in Modem Sharing Unit (MSU) capability allows you to share all of the modem's bandwidth on a single Time Division Multiplexer (TDM) channel. MSU capability is a feature of the multiplexer option and may be used in all of the modulation modes (except V.33), whether point-to-point or multipoint. The operation is equivalent to integration of one MSU into the modem. Each port configured for MSU operation receives the entire channel bandwidth and contends, via the RTS (Request To Send) signal, to transmit on the entire channel bandwidth allocated for MSU operation. When a port has been granted the channel, that port receives the CTS (Clear To Send) signal, and the CTS signals for all other ports assigned to the MSU are held inactive. When the active MSU port drops its RTS, the contention phase for the CTS signal begins again.

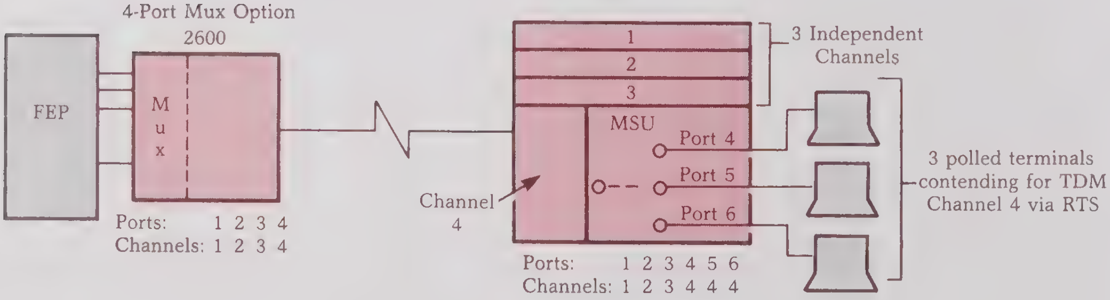
Assignment of ports to the MSU function is independent of mux mode selection, but only one TDM channel may be allocated to MSU operation (see Figure 3-2). ■ **Note:** Only one channel of the TDM (user-specified) can be defined for MSU operation.


FEP
2600
M
u
x
Ports: 1 2 3 4
Channels: 1 2 3 4
Mux
2600
1
2
3
4
Ports: 1 2 3 4
Channels: 1 2 3 4

(A) Multiplexing Option


CHANNEL
T1
T2
T3
T4
P1
P2
P3
P4
P5
P6
Point-to-Point
full-duplex channels
(Normal TDM)
Multipoint (polled or contention)
Port Selection depends on which port raises RTS.
That port receives entire bandwidth.

(B) Configuration of Channel Contention


4-Port Mux Option
2600
FEP
M
u
x
Ports: 1 2 3 4
Channels: 1 2 3 4
1
2
3
3 Independent Channels
MSU
Port 4
Port 5
Port 6
Channel 4
Ports: 1 2 3 4 5 6
Channels: 1 2 3 4 4 4
3 polled terminals contending for TDM Channel 4 via RTS

(C) Mux/MSU Options

Figure 3-2. Mux/MSU Port-to-Channel Mapping

Table 3-6.
Standard 4-Port Mux Channel Configurations

Mux Mode	*Channel*	*Main Channel Rate* 4.8	7.2	9.6	12.0	14.4	16.8
1	1	4.8	7.2	9.6	12.0	14.4	16.8
	2	[9] —	[6] —	[1] —	—	—	—
	3	—	—	—	—	—	—
	4	—	—	—	—	—	—
2	1	2.4	4.8	7.2	9.6	9.6	12.0
	2	[10] 2.4	[7] 2.4	[2] 2.4	2.4	4.8	4.8
	3	—	—	—	—	—	—
	4	—	—	—	—	—	—
3	1	2.4	4.8	4.8	7.2	7.2	9.6
	2	[10] 2.4	[7] 2.4	[3] 4.8	4.8	7.2	7.2
	3	—	—	—	—	—	—
	4	—	—	—	—	—	—
4	1	2.4	2.4	4.8	4.8	4.8	7.2
	2	[10] 2.4	[8] 2.4	[4] 2.4	4.8	4.8	4.8
	3	—	2.4	2.4	2.4	4.8	4.8
	4	—	—	—	—	—	—
5	1	2.4	2.4	2.4	4.8	4.8	7.2
	2	[10] 2.4	[8] 2.4	[5] 2.4	2.4	4.8	4.8
	3	—	2.4	2.4	2.4	2.4	2.4
	4	—	—	2.4	2.4	2.4	2.4
6	1	2.4	2.4	4.8	4.8	4.8	7.2
	2	1.2	2.4	2.4	4.8	4.8	4.8
	3	1.2	2.4	2.4	2.4	4.8	4.8
	4	—	—	—	—	—	—
7	1	1.2	2.4	2.4	4.8	4.8	7.2
	2	1.2	2.4	2.4	2.4	4.8	4.8
	3	1.2	1.2	2.4	2.4	2.4	2.4
	4	1.2	1.2	2.4	2.4	2.4	2.4
USER 1 (MUX 1✳ Default Values)§	1	2.4	2.4	4.8	7.2	9.6	9.6
	2	2.4	2.4	2.4	2.4	2.4	4.8
	3	—	2.4	2.4	2.4	2.4	2.4
	4	—	—	—	—	—	—
USER 2 (MUX 2✳ Default Values)§	1	2.4	2.4	2.4	4.8	7.2	9.6
	2	2.4	2.4	2.4	2.4	2.4	2.4
	3	—	2.4	2.4	2.4	2.4	2.4
	4	—	—	2.4	2.4	2.4	2.4
14 — 15		Reserved (Unused)					

§See Configuration Tree in Chapter 2.

■ **Notes:**
1) The red values indicate V.29-defined mux modes as labeled in CCITT V.29 specifications. [ ] indicates V.29 Multiplexer Configuration Number.
2) In each mux mode, unused ports (which can be assigned to the same channel as an existing port for MSU) are shown by a dash "—".
3) If mux modes 8 to 11 are selected in a 4-port unit, ports 5 and 6 are not active.
4) USER 1 is Network Management Systems User-Defined Mux.

Table 3-7.
Standard 6-Port Mux Channel Configurations

Mux Mode	*Channel*	*Main Channel Rate*					
		4.8	*7.2*	*9.6*	*12.0*	*14.4*	*16.8*
1 to 7	1 to 4	Same as 4-Port Mux (See Table 3-6)					
	5, 6	—	—	—	—	—	—
8	1	2.4	2.4	2.4	2.4	4.8	4.8
	2	2.4	2.4	2.4	2.4	2.4	4.8
	3	—	2.4	2.4	2.4	2.4	2.4
	4	—	—	2.4	2.4	2.4	2.4
	5	—	—	—	2.4	2.4	2.4
	6	—	—	—	—	—	—
9	1	2.4	2.4	2.4	2.4	2.4	4.8
	2	2.4	2.4	2.4	2.4	2.4	2.4
	3	—	2.4	2.4	2.4	2.4	2.4
	4	—	—	2.4	2.4	2.4	2.4
	5	—	—	—	2.4	2.4	2.4
	6	—	—	—	—	2.4	2.4
10	1	1.2	2.4	2.4	2.4	4.8	4.8
	2	1.2	1.2	2.4	2.4	2.4	4.8
	3	1.2	1.2	2.4	2.4	2.4	2.4
	4	1.2	1.2	1.2	2.4	2.4	2.4
	5	—	1.2	1.2	2.4	2.4	2.4
	6	—	—	—	—	—	—
11	1	1.2	1.2	2.4	2.4	2.4	4.8
	2	1.2	1.2	2.4	2.4	2.4	2.4
	3	1.2	1.2	1.2	2.4	2.4	2.4
	4	1.2	1.2	1.2	2.4	2.4	2.4
	5	—	1.2	1.2	1.2	2.4	2.4
	6	—	1.2	1.2	1.2	2.4	2.4
USER 1 (MUX 1✳ Default Values)§	1	2.4	2.4	4.8	7.2	9.6	9.6
	2	2.4	2.4	2.4	2.4	2.4	4.8
	3	—	2.4	2.4	2.4	2.4	2.4
	4	—	—	—	—	—	—
	5	—	—	—	—	—	—
	6	—	—	—	—	—	—
USER 2 (MUX 2✳ Default Values)§	1	2.4	2.4	2.4	4.8	7.2	9.6
	2	2.4	2.4	2.4	2.4	2.4	2.4
	3	—	2.4	2.4	2.4	2.4	2.4
	4	—	—	2.4	2.4	2.4	2.4
	5	—	—	—	—	—	—
	6	—	—	—	—	—	—
14 — 15	Reserved (Unused)						

§See Configuration Tree in Chapter 2.

■ **Notes:** 1) USER 1 is Network Management Systems User-Defined Mux.
2) In each mux mode, unused ports (which can be assigned to the same channel as an existing port for MSU) are shown by a dash "—".

Table 3-8.
2680 Mux Channel Configurations

Mux Mode	*Channel*	*Main Channel Rate*			
		12.0	*14.4*	*16.8*	*19.2*
1	1	12.0	14.4	16.8	19.2
2	1	9.6	12.0	14.4	16.8
	2	2.4	2.4	2.4	2.4
3	1	7.2	9.6	12.0	14.4
	2	4.8	4.8	4.8	4.8
4	1	7.2	9.6	12.0	14.4
	2	2.4	2.4	2.4	2.4
	3	2.4	2.4	2.4	2.4
5	1	7.2	7.2	9.6	9.6
	2	4.8	7.2	7.2	9.6
6	1	4.8	7.2	9.6	9.6
	2	4.8	4.8	4.8	4.8
	3	2.4	2.4	2.4	4.8
7	1	4.8	7.2	9.6	9.6
	2	2.4	2.4	2.4	4.8
	3	2.4	2.4	2.4	2.4
	4	2.4	2.4	2.4	2.4
8	1	4.8	4.8	7.2	7.2
	2	4.8	4.8	4.8	7.2
	3	2.4	4.8	4.8	4.8
9	1	4.8	4.8	7.2	9.6
	2	2.4	4.8	4.8	4.8
	3	2.4	2.4	2.4	2.4
	4	2.4	2.4	2.4	2.4
10	1	2.4	4.8	4.8	4.8
	2	2.4	2.4	4.8	4.8
	3	2.4	2.4	2.4	4.8
	4	2.4	2.4	2.4	2.4
	5	2.4	2.4	2.4	2.4
11	1	2.4	2.4	4.8	4.8
	2	2.4	2.4	2.4	4.8
	3	2.4	2.4	2.4	2.4
	4	2.4	2.4	2.4	2.4
	5	2.4	2.4	2.4	2.4
	6	—	2.4	2.4	2.4

(continued on next page)

Table 3-8 (continued).
2680 Mux Channel Configurations

Mux Mode	*Channel*	*Main Channel Rate*			
		12.0	*14.4*	*16.8*	*19.2*
USER 1 (MUX 1✳ Default Values)§	1	7.2	9.6	9.6	4.8
	2	2.4	2.4	4.8	4.8
	3	2.4	2.4	2.4	4.8
	4	—	—	—	4.8
USER 2 (MUX 2✳ Default Values)§	1	4.8	7.2	9.6	4.8
	2	2.4	2.4	2.4	4.8
	3	2.4	2.4	2.4	4.8
	4	2.4	2.4	2.4	2.4
	5	—	—	—	1.2
	6	—	—	—	1.2
14 — 15	Reserved (Unused)				

§See Configuration Tree in Chapter 2.

■ **Note:** User 1 is Network Management Systems User-Defined Mux.

Table 3-9.
V.33 Multiplexer Configurations

Mux Mode	*Channel*	*Main Channel Rate*	
		12.0	*14.4*
1	1	[1] 12.0	[1] 14.4
2	1	[2] 9.6	[2] 12.0
	2	2.4	2.4
3	1	[3] 7.2	[3] 9.6
	2	4.8	4.8
4	1	[4] 7.2	[4] 9.6
	2	2.4	2.4
	3	2.4	2.4
5	1	[3] 7.2	[5] 7.2
	2	4.8	7.2
6	1	[5] 4.8	[5] 7.2
	2	4.8	4.8
	3	2.4	2.4
7	1	[6] 4.8	[7] 7.2
	2	2.4	2.4
	3	2.4	2.4
	4	2.4	2.4
8	1	[5] 4.8	[8] 4.8
	2	4.8	4.8
	3	2.4	4.8
9	1	[6] 4.8	[9] 4.8
	2	2.4	4.8
	3	2.4	2.4
	4	2.4	2.4
10	1	[7] 2.4	[10] 4.8
	2	2.4	2.4
	3	2.4	2.4
	4	2.4	2.4
	5	2.4	2.4
11	1	[7] 2.4	[11] 2.4
	2	2.4	2.4
	3	2.4	2.4
	4	2.4	2.4
	5	2.4	2.4
	6	—	2.4
12	Reserved (Unused)		
13	Reserved (Unused)		
14	Reserved (Unused)		
15	V.33 Remotely Programmable Mux Mode		

■ **Note:** [ ] indicates V.33 Multiplexer Configuration Number.

Control Signaling

The control signaling features operate on a port/channel of a constant carrier multiplexed modem to simulate half-duplex EIA control signal handling and/or to permit remote monitoring and control of second-tier dial circuits. When half-duplex or dial circuits are remotely connected to a host or front end processor through a constant carrier multiplexed circuit, the usual EIA control signal information is lost. The control signaling feature restores the normal passage of control signal information, as shown in Figure 3-3.

The CCITT V.33 Recommendation specifies a method for simulating half-duplex operation using an inband control signaling method. The specified RTS/DCD signaling method is compatible with the method decsribed below (though it is not compatible with other Codex modems because it uses a different algorithm). The 2666 Modem includes the added capability of DTR/DSR signaling, though this is not specified in the CCITT V.33 recommendation.

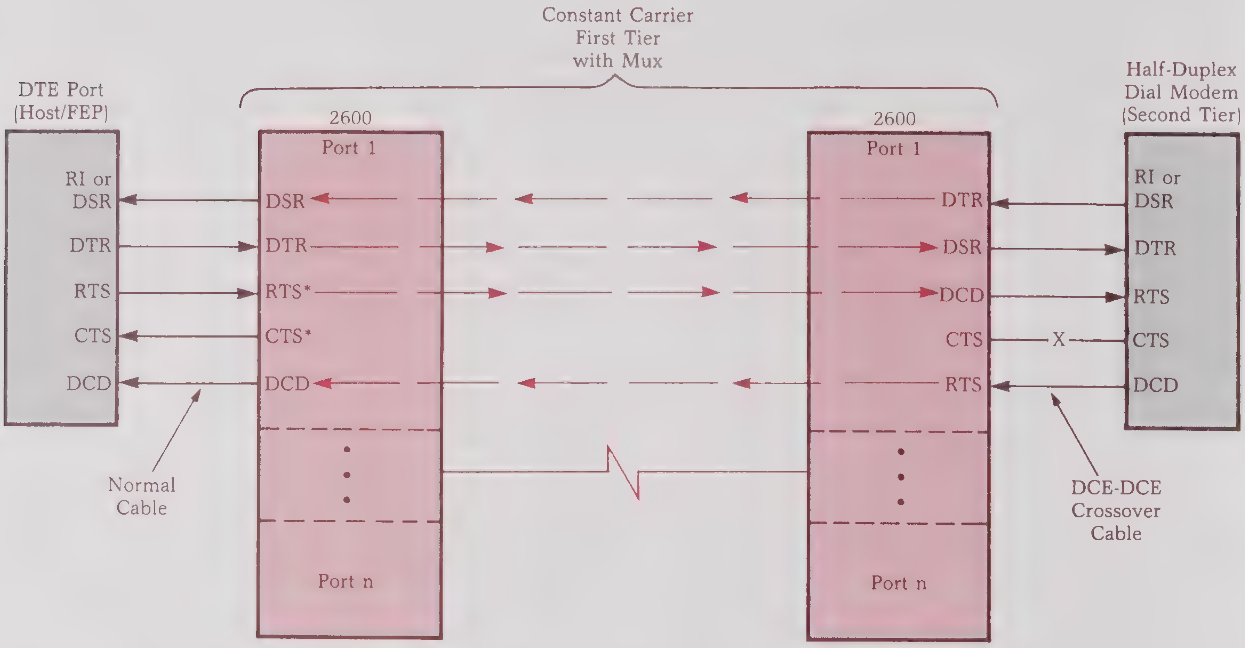
With reference to Figure 3-3, the following explains how the DTE can monitor and control the remote dial modem.

- ***DTR-DSR Control Signaling and Dial Connection/Disconnection Control***

  Dial Connect. If EIA Ring Indicator (RI) signals through the DTR-DSR control signaling feature, the DTE can leave DTR Off and wait for the dial tail circuit modem to detect a ring. The Ring Indicator relays through the first tier via control signaling. The DTE can turn DTR On (in response to RI) to allow the modem to answer the incoming call. Control signaling passes the DTR signal through the first tier to the dial modem.

  Signal to Host that Call was Answered. If EIA DSR signals through the DTR-DSR control signaling feature, the DTE can leave DTR On and wait for the dial tail circuit to answer an incoming call. The dial tail circuit modem's DSR comes On when the call has been accepted. Control signaling passes the DSR signal to the DTE to prompt for LOGON, and so on.

  Dial Disconnect. When the DTE terminates a call at the dial tail circuit modem, it drops its own DTR. Control signaling passes the DTR drop to the dial modem, which disconnects the dial call.


Constant Carrier
First Tier
with Mux
DTE Port
(Host/FEP)
Half-Duplex
Dial Modem
(Second Tier)
2600
Port 1
2600
Port 1
RI or
DSR
DTR
RTS
CTS
DCD
DSR
DTR
RTS*
CTS*
DCD
DTR
DSR
DCD
CTS
RTS
X
RI or
DSR
DTR
RTS
CTS
DCD
Normal
Cable
DCE-DCE
Crossover
Cable
Port n
Port n

*A port RTS-CTS delay must be selected here to allow sufficient time for the half-duplex tail circuit to train and be ready to transmit the data passed through the first tier.

X = No Connection

Note: 2600 Series Modems do not have a ring indicator; however, a ring indicator is present on half-duplex dial modems and front-end ports.

Figure 3-3. Control Signaling

- ***RTS/DCD Control Signaling and Simulated Half-Duplex Operation***

  When the DTE raises/lower RTS, control signaling turns DCD On/Off at the other end of the first tier. DCD connects to RTS on the remote half-duplex tail circuit modem; therefore, the DTE's RTS controls the remote RTS. This permits the half-duplex remote modem to raise and lower carrier appropriately, as if the DTE were directly connected.

  When the remote modem detects carrier On/Off and turns DCD On/Off, the crossover cable connects DCD to the first-tier port's RTS. Control signaling raises/lowers DCD at the DTE. This permits the DTE to monitor the remote modem's DCD, just as if the DTE were directly connected. This feature should be used only with data encoded in a standard code such as ASCII or EBCDIC to avoid misinterpreting data as the DCD Off signal. (Do not use this feature with FAX machines.) The design of this feature assumes that the user DTE is raising and lowering RTS with each transmission. Otherwise, you may find that DCD is always Off at the opposite end of the link. RTS/DCD control signaling should *not* be enabled on the MSU data channel.

Async-to-Sync Conversion

Asynchronous data can be passed through one or more channels on a 2600 Series Modem link by selecting (on a port-by-port basis) the async-to-sync converter function. The async-to-sync converter (using the V.22 algorithm) accepts asynchronous data, converts the timing to match the synchronous modem timing, and delivers the data with asynchronous timing at the other end. The async-to-sync converter can be used with character lengths of 6, 7, 8, or 9 data/parity bits and is transparent as far as the type of parity and number of stop bits used (1 or 2 stop bits). 1.5 stop bits should never be used. (At 19.2 kbps async, 2 stop bits must be used.) ■ **Note:** Async-to-sync conversion should not be used with 12.0, 14.4, or 16.8 kbps port rates. (Normally, no async DTEs offer these rates.)

POINT-TO-POINT LOOPBACKS

Point-to-point loopbacks can be operated in either direction. Some loopbacks affect the modem main channel, while others affect only a port. In a single port unit, this distinction is not very important, but in a multiport unit the loopbacks that affect only the port will permit testing of one port or channel without interfering with data transmission on other channels. A port loopback will affect the entire main channel in a single-port modem. In this discussion, all point-to-point loopbacks will be illustrated on a multiport modem.

Terminal Loopback

Terminal Loopback affects only one port at a time. It is similar to CCITT V.54 Loop 1, except that it is implemented in the DCE, not the DTE. Port RTS will not affect the main channel. Terminal Loopback loops the following EIA signals: TXD to RXD; RTS to CTS and to DCD; and DTR to DSR (see Figure 3-4).

Digital Loopback

Digital Loopback affects only one port at a time. It is identical to CCITT V.54 Loop 2 and loops the following EIA signals internally: RXD to TXD; DCD to RTS. Loopback timing is forced internally and all external port signals are held Off (see Figure 3-5).

Modem Check (Analog Loopback)

Modem Check affects the entire main channel. It is similar to CCITT V.54 Loop 3, except that the secondary channel is still enabled. It loops the analog transmitter to the analog receiver through a pad and leaves the port(s) active for test equipment to loop data through the modem (see Figure 3-6). (There is also a V.54 Loop 3; see the CCITT V.54 Loopbacks section further in this chapter). ■ **Note:** In the 2680, the modem will disconnect the embedded control channel to avoid looping back control channel data.

Audio Loopback

Audio Loopback affects the entire main channel (except in the 2680 Modem, where the audio loopback function is not used). It is similar to CCITT V.54 Loop 4, except that it is an active, not passive, audio loop. The received line signal is looped back to the transmit line with gain adjustment to maintain the configured transmit level (see Figure 3-7). ■ **Note:** On the 2666 modem, internal hardware straps disable the audio loopback feature.

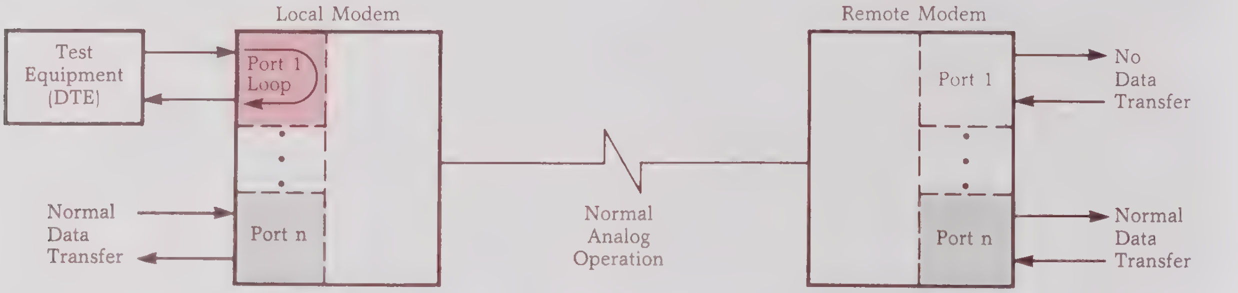

Local Modem
Remote Modem
Test Equipment (DTE)
Port 1 Loop
Port n
Normal Data Transfer
Normal Analog Operation
Port 1
No Data Transfer
Port n
Normal Data Transfer

Figure 3-4. Terminal Loopback on Port 1

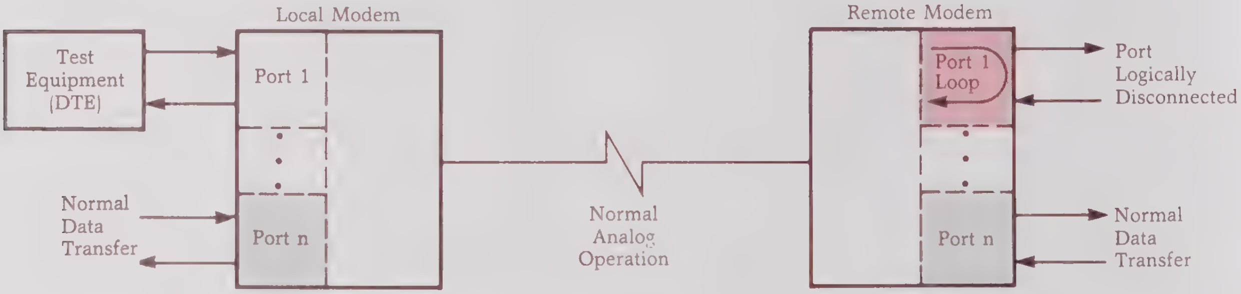

Local Modem
Remote Modem
Test Equipment (DTE)
Port 1
Port n
Normal Data Transfer
Normal Analog Operation
Port 1 Loop
Port Logically Disconnected
Port n
Normal Data Transfer

Figure 3-5. Digital Loopback on Port 1 (CCITT V.54, Loop 2)

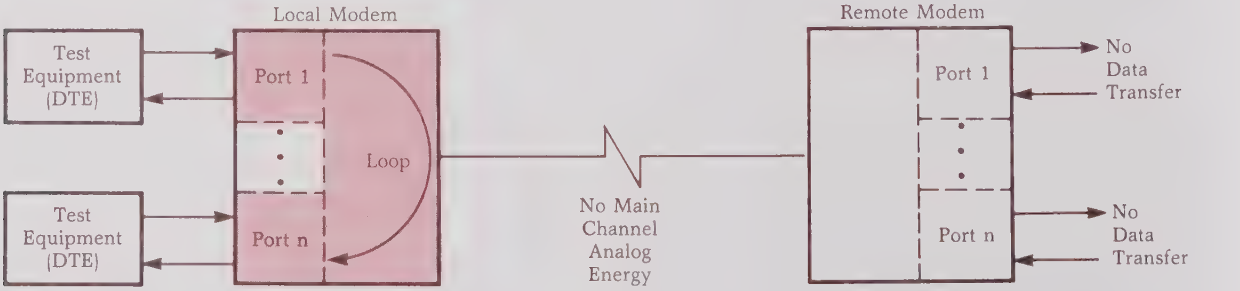

Local Modem
Remote Modem
Test Equipment (DTE)
Port 1
Loop
Test Equipment (DTE)
Port n
No Main Channel Analog Energy
Port 1
No Data Transfer
Port n
No Data Transfer

Figure 3-6. Modem Check

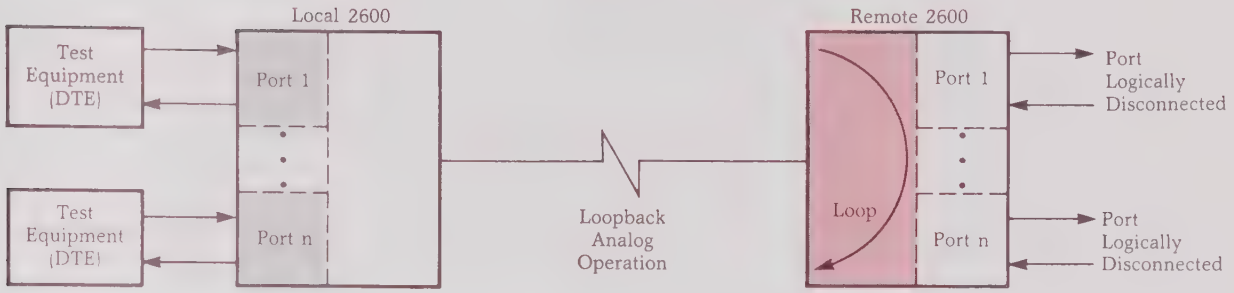


Figure 3-7. Audio Loopback

POINT-TO-POINT TESTS

Poll Test

The Poll Test is an end-to-end test that is most applicable for block error rate testing of point-to-point networks or for testing multipoint networks. In a Poll Test, the modems disconnect from the network and the master modem sends simulated polls to each slave, which then responds with a simulated poll in a ping-pong manner. The modems count the number of polls in error and the number of missing polls. When initiated from Network Management Systems, the test message lengths, slave address list, and number of polls per slave are operator-configurable. When initiated from the modem Control Panel, the test message is fixed as one ''QUICK BROWN FOX''. One slave is tested at a time, and the test is automatically run for 256 polls. Whether initiated by Network Management Systems or the modem Control Panel, the test always uses port 1 when run with the multiplexer option. ■ **Note:** The port number for the Poll Test is selectable by Network Management Systems but not from the 2600 Series Control Panel.

BER Test

The Bit Error Rate (BER) Test is an end-to-end test that is most applicable for testing point-to-point networks (especially with multiplexer options). In a BER Test, the modems disconnect from the network, send a test pattern to each other, and count bit errors in the received test pattern. When initiated from Network Management Systems, the length of the test pattern as well as the test pattern are user-configurable. When initiated from the modem Control Panel, the test length is fixed as 10^6 bits and the test pattern character is ''1010 1010''. Whether initiated by Network Management Systems or the modem Control Panel, the port (channel) to be tested is user-configurable when run with a multiplexer option.

Self Test

The Self Test is a device test of the modem in which the modem disconnects itself from the network (including the network control channel) and internally loops test patterns through itself. It records any failures detected by identifying the board that appears to be faulty for service or repair of the faulty unit. The Self Test can be initiated from Network Management Systems or the Control Panel. When initiated from Network Management Systems, the test is executed once only. When initiated from the modem Control Panel, the test can be executed once only (default) or can be run continuously. The latter can be activated and cancelled locally only and not via the remote Control Panel feature.

Test Tone

In point-to-point applications for 2600 Series modems, one modem is set up to generate the 1004 Hz Test Tone. The modem also disconnects its receiver and CQMS. The modem at the other end of the link is physically disconnected (or patched) from the audio line and replaced with an analog test set to calculate Receive Level, C-Notched noise power measurements, and Signal-to-Noise Ratio. See Figure 3-8.

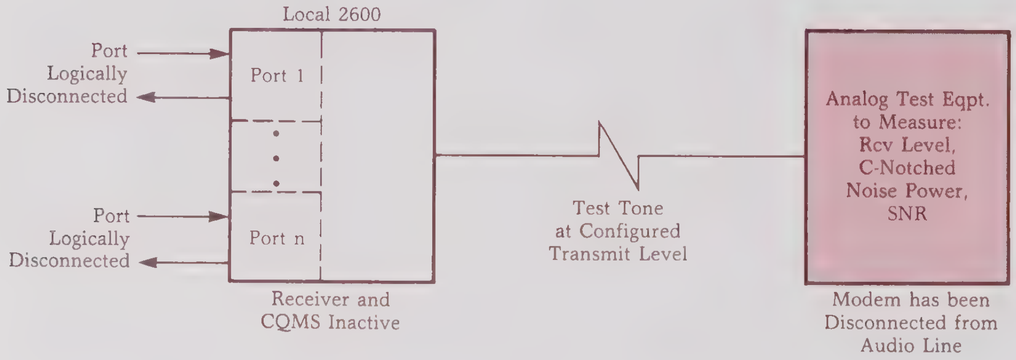

Local 2600
Port Logically Disconnected
Port 1
Port Logically Disconnected
Port n
Receiver and CQMS Inactive
Test Tone at Configured Transmit Level
Analog Test Eqpt. to Measure: Rcv Level, C-Notched Noise Power, SNR
Modem has been Disconnected from Audio Line

Figure 3-8. Test Tone

Special Control Signal Handling in Loopbacks and Tests

The use of loopbacks and tests generally causes EIA/CCITT control signals to be turned Off because the function they normally represent is disabled by the test condition. However, some DTEs interact poorly with a modem that turns off EIA/CCITT control signals during tests (such as logging the line off, refusing to execute loop testing, or requiring a Front End reboot to reenable the line). Three port straps can be used to override the effects of loopbacks on the handling of EIA/CCITT control signals (see Chapter 4). (They also override the normal operation of the EIA/CCITT control signals in response to other modem or link conditions.)

- ***DCD Always On:*** This strap leaves DCD On during all test conditions or dropouts even if the test would normally turn DCD Off.
- ***CTS Follows RTS:*** This strap always returns CTS in response to RTS even if a test condition would normally keep CTS Off.
- ***DSR Always On:*** This strap keeps DSR On during all test conditions even if the test would normally turn DSR Off.

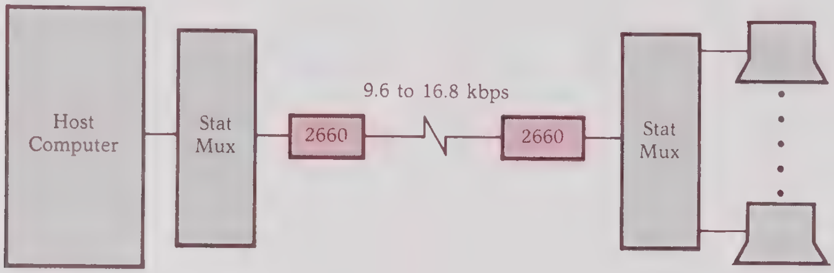


Figure 3-9. 2680 Modem ARS Advantage

APPLICATIONS

2680 Modem ARS Advantage

Carrington Island, a desirable vacation spot for residents of nearby Wayne County, can be reached only by ferries of the Wayne County and Carrington Steamship Authority. Thousands of would-be travelers call the authority daily to make or change ferry reservations. These calls are handled by ticket agents stationed at 11 remote terminals. The terminals, with an aggregate port speed of 26.4 kbps, are multiplexed to a central site host computer over a 9600 bps high-speed link.

The ticket agents are experiencing such delays in sending and receiving booking information that travelers listen endlessly to recorded music. The turnover rate of frustrated agents is high, and agent morale and customer satisfaction are low.

The 9600 bps modems presently used cannot provide the required throughput over a single line. Adding a second line with 9600 bps would be prohibitively expensive.

What is the best solution?

The Codex 2680 adaptive rate modems with 64-State 8-Dimensional Trellis-Coded Modulation (64 x 8 TCM) ensure unsurpassed performance over 3002, D1 lines with greater immunity to noise and other distortions than any comparable modems. 64 x 8 TCM enables the Codex 2680 to transmit more data with fewer errors than modems using uncoded schemes. Also, the Adaptive Rate System (ARS) directs the modems to automatically transmit at the highest speed that line conditions allow, up to 19.2 kbps (see Figure 3-9).

The new Codex modems will overcome the existing bottleneck; soon there will be more visitors to Carrington and less disposable cash in Wayne County.

2660 Modem MSU Advantage

Don Waite, chairman of the board of Mutual Agreement, a national insurance company with headquarters in Las Vegas, is concerned about increasing numbers of policy cancellations. An investigation showed customers irate about high coverage costs and slow claims processing.

An outmoded data communications network is contributing to both problems, and Waite has assigned the following goals to Kathy Wyman, Mutual's MIS manager:

- Reduce data communications costs
- Boost throughput
- Increase uptime

What is the best way to accomplish these objectives?

Wyman found that the Codex 2660 modem amply satisfies all three goals. The high speed of the 2660 modem allows fewer leased telephone lines, thus reducing line costs, and increasing total throughput. With built-in network control, lines and devices can be monitored, tested, and reconfigured to increase uptime.

In Wyman's proposal, data streams from district offices around the country are handled at the Chicago site by the Codex 2660 optional 6-channel buffered multiplexer. Data is then routed back to the Las Vegas host over a single 16.8 kbps high-speed line (see Figure 3-10).

To make maximum use of a limited number of computer ports, the Codex 2660 integral Modem Sharing Unit (MSU), standard with the multiplexer option, allows two colocated terminals to contend for the same channel. Another port accommodates a multipoint line with drops from Chicago to Boston. Also, a temporary dial backup connecting Chicago and Atlanta uses the Dual Dial Restoral (DDR) Option to bypass a failed 3002 leased line via the Network Management Systems central site in Las Vegas.

The multiplexer option is configured so that if the high-speed line needs to fall back from 16.8 kbps (the Adaptive Rate System will do this automatically), the only device that falls back to accommodate the slowdown is the Remote Job Entry (RJE) equipment in Chicago. The rest of the network operates unchanged.

Waite, delighted with the proposal, is convinced that the Codex equipment will help improve Mutual's profitability and keep customers satisfied.

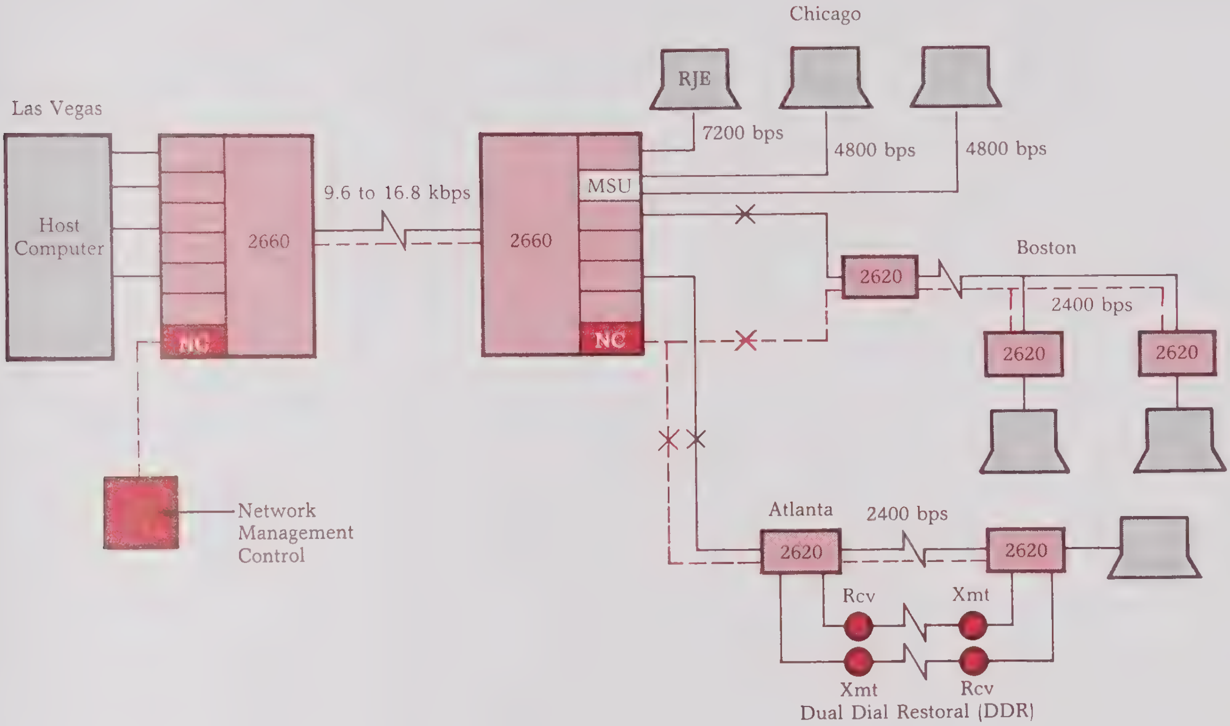

Chicago
RJE
7200 bps
4800 bps
4800 bps
Las Vegas
Host Computer
2660
NC
9.6 to 16.8 kbps
2660
MSU
NC
2620
Boston
2400 bps
2620
2620
Network Management Control
Atlanta
2400 bps
2620
2620
Rcv
Xmt
Xmt
Rcv
Dual Dial Restoral (DDR)

Figure 3-10. 2660 Modem MSU Advantage

Chapter 4
Multipoint

Contents

General 4-1
Multipoint Applications 4-6
  CQMS in Multipoint Applications 4-7
  High-Speed Multipoint Modes 4-7
  MP Mode (Master and Slave) 4-7
  Codex CS48FP Mode 4-8
  V.27 *bis* Multipoint Mode 4-10
  Modem Sharing Feature 4-10
  Port-to-Channel Mapping 4-10
Multipoint Loopbacks 4-10
  Terminal Loopback 4-10
  Digital Loopback 4-12
  Modem Check (Analog Loopback) 4-12
  Audio Loopback 4-12
Multipoint Tests 4-12
  Poll Test 4-12
  BER Test 4-12
  Self Test 4-14
  Test Tone 4-14
  Special Control Signal Handling in
    Loopbacks and Tests 4-15
Applications 4-16
  2640 Modem and Network Management
    Systems 4-16
  2650 Modem High-Speed Advantage 4-16

GENERAL

The 2650 High-Speed Multipoint Modem is intended for data communications applications that require maximum effective throughput in multipoint networks. An accelerated response time, outbound rates that you can configure up to 16.8 kbps, and automatic retrain on the outbound line are features unique to the 2650. This means an increased number of transactions per hour and better performance over your multipoint lines. The outbound performance of the 2650 Modem at 14.4 kbps approaches that of current 9600 bps point-to-point modems.

Two different types of operating modes are offered in the 2650: High-Speed Multipoint Mode (HSMP) and Multipoint Mode (MP). The HSMP mode provides you with a range of operation in 2400 bps increments from 9.6 to 16.8 kbps outbound and from 4.8 to 9.6 kbps inbound. The MP mode, which utilizes Codex-Improved (CI) 9600 modulation, is fully compatible with the 2640 Modem in multipoint applications. Both inbound and outbound speeds range from 4.8 to 9.6 kbps and a 17 ms training time is implemented in the master modem.

The Codex 2640 is designed for multipoint as well as point-to-point applications. The 2640's unique Mixed Inbound Rates (MIR) feature allows master modems to accept different inbound rates from slave modems in multipoint environments. This is accomplished by including rate information in the slave-to-master synchronization. By eliminating the need to reduce speeds at all multipoint drops if only one or a few lines degrade, MIR provides increased throughput in multipoint applications. In addition, in multipoint modes training is accomplished in 17 ms in the inbound direction. The outbound operation uses a constant carrier mode with improved Signal-to-Noise Ratio (SNR) performance.

The Codex 2620 primarily supports basic multipoint applications either independently or as part of a network management system. The 2620 offers compatibility with Codex CS48FP modems as well as compatibility with CCITT V.27 *bis* recommendations (see Chapter 3 for an explanation of the point-to-point V.27 *bis* mode).

The 2640 and 2620 increase throughput in multipoint applications with their Train On Data (TOD) feature. TOD eliminates data-disruptive retrains by allowing slave modems to retrain or equalize on the data being transmitted. Eliminating retrains means greater throughput and faster response times in multipoint environments. Additionally, slave modems can be individually identified and characterized via the distinctive Multipoint Signal Quality Binning (MSQB) feature. MSQB allows line quality information to be identified and attributed to specific multipoint drops to provide more exact line information for faster operator action.

Table 4-1 gives product features specific to each modem type. Table 4-2 lists the operating modes available in multipoint configurations. Table 4-3 and 4-4 offer summary information on product configurations.

Table 4-1.
2600 Series Product Features

Feature	*Model 2650*	*Model 2640*	*Model 2620*
Control Panel (with Remote Capability)	Yes	Yes	Yes
Network Management Systems	DNCS 200/300 Codex 4850/4860	DNCS 200/300 Codex 4850/4860	DNCS 200/300 Codex 4850/4860
Network Management System Control Channel	FSK 75/110 bps	FSK 75/110/150 bps (150 bps in CS48FP modes only)	FSK 75/110/150 bps (150 bps in CS48FP or V.27 modes only)
Circuit Quality Monitoring System (CQMS)	Yes	Yes	Yes
Multipoint Signal Quality Binning (MSQB)	Yes	Yes (MP Mode)	No
Mixed Inbound Rates	Yes	Yes (MP Mode)	No
Eye Pattern Generator (Standard)	Yes	Yes	Yes
Power-Up Self Test	Yes	Yes	Yes
Data Handling	Sync Async 6 to 9 bits Block Isoc	Sync Async 6 to 9 bits Block Isoc	Sync Async 6 to 9 bits Block Isoc
CCITT V.54 Circuits 140/141/142	Yes	Yes	Yes
RTS Control Signaling	Yes	Yes	Yes
DTR Control Signaling	Yes	Yes	Yes
Multiport (4) Option			
4 DTE Ports	Yes	Yes	Yes
2- to 4-Port MSU	Yes	Yes (All Modes)	Yes (All Modes)
User-Configurable TDM	Yes	Yes	Yes
Compatible Mux Configurations	N/A	N/A	None
Audio Features			
Domestic 4-Wire Leased	3002	3002	3002
International 4-Wire Leased	M1040	M1040	M1040
Dual Dial Restoral Option			
FCC Part 68 Registered	Yes	Yes	Yes
Manual or Auto Answer	Yes	Yes	Yes
Automatic Dialing (DTMF or Universal Pulse Dialing)	Yes	Yes	Yes
Power Fail Alarm	Yes	Yes	Yes

Table 4-2.
2600 Series Operating Modes

Operating Mode	*Data Rate (kbps)*	*Transmit Carrier Mode*	*Telephone Line Requirements*	*Training Time (ms)*	*Equalization Recovery Method**	*Unique Features*
HSMP-M	16.8 14.4 12.0 9.6	Constant	3002 M1040	492 392 292 192	None	Accelerated response time; automatic retrain on outbound; Mixed Inbound Rate
HSMP-S	9.6 7.2 4.8	Controlled	3002 M1040	17	Cry For Help	Cry For Help (CFH)
MP-M (Master)	9.6 7.2 4.8	Constant	3002 M1040	253	None (Retrain expected with each inbound message)	Mixed Inbound Rate; MSQB
MP-S (Slave)	9.6 7.2 4.8	Controlled	3002 M1040	17	Train On Data (2 to 15 sec)	Train On Data (TOD)
CS48FP-M (Master)	4.8 2.4	Constant	3002 M1040	49	None (Retrain expected with each inbound message)	Compatible with Codex CS48FP
CS48FP-S (Slave)	4.8 2.4	Controlled	3002 M1040	9	Train On Data (2 to 15 sec)	Compatible with Codex CS48FP
V.27-M (Master)	4.8 2.4	Constant	3002 M1040	708 943	None (Retrain expected with each inbound message)	Compatible with CCITT V.27 *bis* (without network control)
V.27-S (Slave)	4.8 2.4	Controlled	3002 M1040	50 67	Train On Data (2 to 15 sec)	Train On Data (TOD); compatible with CCITT V.27 *bis* (without network control)

*Approximate recovery time.

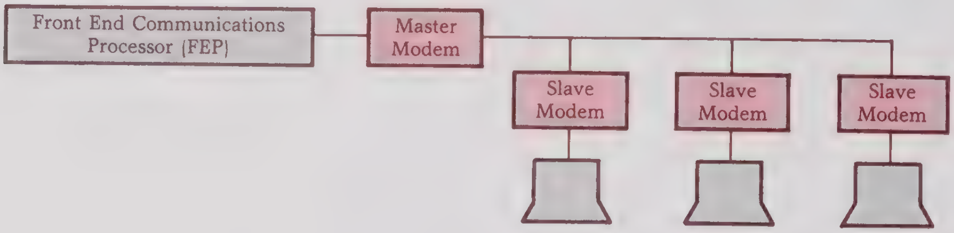
Table 4-3.
2600 Series Product Configurations

Operating Modes	*2650*	*2640*	*2620*
HSMP (Master and Slave)	●		
MP (Master and Slave) (9.6, 7.2, 4.8 kbps)	●	●	
CS48FP-S (Slave) (4.8, 2.4 kbps)		●	●
CS48FP-M (Master) (4.8, 2.4 kbps)			●
V.27 *bis* (Master and Slave) (4.8, 2.4 kbps)			●

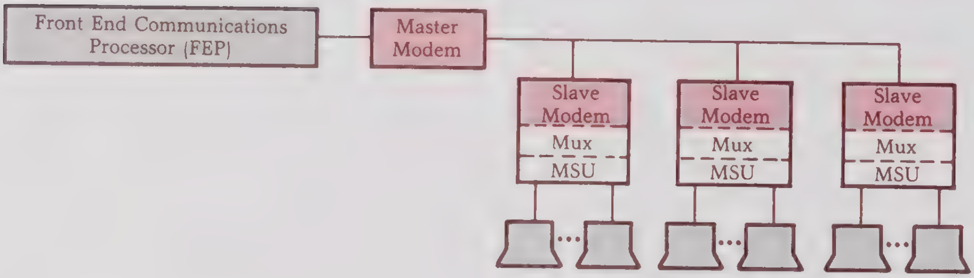
*Limited to 4.8 kbps in 2620.

Table 4-4.
Recommended Operating Modes

Application	*Recommended Mode*
14.4 kbps	HSMP-M or HSMP-S
9.6 kbps	MP-M or MP-S
Codex CS48FP Compatibility	CS48FP-M or CS48FP-S
CCITT V.27 *bis* Compatibility	V.27-M or V.27-S (If compatibility not required, CS48FP modes are recommended for 4.8 kbps multipoint operation.)


Front End Communications Processor (FEP)
Master Modem
Slave Modem
Slave Modem
Slave Modem

(A) Basic Multipoint System


Front End Communications Processor (FEP)
Master Modem
Slave Modem
Mux
MSU
Slave Modem
Mux
MSU
Slave Modem
Mux
MSU

■**Note:** The Mux Option must be configured as MSU in multipoint applications.

(B) Multipoint System with Modem Sharing Unit Feature

Figure 4-1. Multipoint Systems

MULTIPOINT APPLICATIONS

Figure 4-1(A) illustrates a basic multipoint circuit (also referred to as a multidrop or polling network); Figure 4-1(B) illustrates a multipoint circuit with a modem sharing feature. In these examples, the data from the Front End Processor (FEP) is fed to a master modem. The master modem is continuously transmitting data down the constant carrier telephone line to all of the slave modems. Since all of the modems are receiving the same data, all of the terminals are receiving the same data. Each terminal has a previously assigned address and will compare this to the address received at the start of the polled message. If the address in the message is correct, the terminal processes the data, but if the address does not correspond, the message is ignored. When a terminal wishes to respond to a poll from the FEP, it raises Request To Send, which enables the slave modem's transmitter. At this time, a training sequence is sent by the slave modem to initialize the master's receiver. All slaves normally hold carrier off until RTS is raised, and only one slave can communicate with the master at a given time. A multiplexing option can be purchased for any or all slave modems in order to use the Modem Sharing Unit (MSU) feature.

In multipoint applications, the master modem will automatically train all slaves when the master is first powered on. Thereafter, operation is quite different from point-to-point applications.

Slave receivers automatically detect changes in line condition that result in an abnormal error rate (normally 1 error in 10^3 bits for 2 seconds) and loss of equalization. At this point, an Unattended Initiate (UI) takes place. Rather than employing Round Robin as in point-to-point, a TOD feature is used to retrain the modem. In the TOD feature, Received Data is clamped to a Mark and the receiver goes offline for a period of 10 to 15 seconds, depending upon line conditions. Through TOD, the slave modem relearns the line equalization based on the customer data sequence sent by the master modem. Once equalization is recovered, the modem goes back online and reactivates Received Data. This is all done without interfering with the master or other slave modems and does not require any action from Network Management Systems. Because each inbound transmission is preceded by a train, no equalization recovery techniques are required in the inbound direction.

CQMS in Multipoint Applications

In multipoint applications, CQMS operates on the outbound line the same way as in point-to-point applications. The continuous parameters (described in the paragraph on CQMS in Point-to-Point Applications earlier in this chapter) can be monitored by Network Management Systems or the Control Panel for all slave modems. These parameters are *not* valid at the master modem in normal operation because the inbound polls are too short to allow averaging of continuous parameters. The only parameters that are valid in normal operation are blown polls and Multipoint Signal Quality. Blown polls are those in which errors due to poor circuit quality are detected at the end of the training sequence. Multipoint Signal Quality measures the percent of polls received with high error probability in the data immediately following the training sequence due to poor circuit quality. The continuous parameters *are* valid in a master modem during a continuous carrier test, such as the BER Test.

High-Speed Multipoint Modes

High-Speed Multipoint operating modes—HSMP-M and HSMP-S—are compatible only with other 2650 modems. Equalization recovery is accomplished through the Cry For Help (CFH) function, permitting automatic retrain of slaves on the outbound line. The CFH technique allows a slave that has lost equalization to request a retrain from the master modem. The slave sends a short signal on the inbound line, which can be detected by the master receiver as something different from a normal inbound training sequence. The master receiver then signals the master transmitter to send a retrain to all slaves.

The CFH signal disrupts data transmission until the retrain occurs. However, after 10 seconds, the frequency of CFH drops to once in every 40 seconds. This minimizes disruption and allows polling to continue; thus, a modem that cannot acquire synchronization on the outbound line will not bring down the whole network. Using the CFH technique ensures that there will be no loss of synchronization in the multipoint system even at high speeds of 14.4 or 16.8 kbps.

You should not use loopback timing for either HSMP mode in the 2650 modem, since it is a complex timing arrangement that does not operate with asymmetrical or mixed inbound rates. For loopback timing, modems cannot have different bit rates or modulation modes on the inbound and outbound links. If you select Digital Loopback, it will force symmetrical inbound and outbound rates as required.

■ **Note:** The 2650 in the HSMP modes cannot function as a tail circuit off a multiplexed point-to-point modem. The multiplexed modem cannot support an asymmetrical rate on any channel.

MP Mode (Master and Slave)

The MP mode for both the 2650 and 2640 allows operation at 9.6, 7.2, and 4.8 kbps over 4-wire unconditioned leased lines and is used in a standard multipoint polling environment. The MP mode allows for (but does not require) asymmetrical operation so that the outbound rate can be configured differently from the inbound rate. Furthermore, the inbound rate from each slave is separately selectable when using the Mixed Inbound Rates (MIR) feature (explained below).

As in point-to-point applications, the outbound direction uses a 253 ms training sequence, which allows the modem to learn all significant channel characteristics. In the inbound direction, the master receiver has a very short training sequence (17 ms), which provides maximum speed in responding to polls.

Mixed Inbound Rates (MIR) Feature. A feature available only in the MP mode is Mixed Inbound Rates (MIR), which allows the 2640 to operate each slave modem's transmitter at a different inbound rate. This increases the efficiency of the system by eliminating the need to reduce the inbound rate of the entire multipoint network as the result of one or two poor drops. For example, one inbound link may operate at 9.6 kbps, while another poorer link may operate at 7.2 kbps. The poorer drop can be reconfigured by Network Management Systems or the Control Panel to operate at the lower rate until the lines can be repaired while the remaining drops continue to operate at their normal rates. Those slave modems that are reconfigured for MIR have a slightly increased training time (approximately 1 ms) that is required to communicate rate information.

Multipoint Signal Quality Binning (MSQB). Another feature of the MP mode is MSQB (Multipoint Signal Quality Binning). MSQB is used with Network Management Systems to individually track the performance of the inbound line from each slave modem by providing the percent of polls from each slave with high error probability. Each slave (up to 15) is assigned a bin by Network Management Systems to individually track its signal quality. As signal quality degrades, the percent of polls with high error probability increases. You should then use the MIR feature (see the MODEM✳ Category in the Configuration Tree section of Chapter 2) to reduce the data rate on the degraded link, thereby improving performance.

Codex CS48FP Mode

The CS48FP mode supports a data rate of 4.8 and 2.4 kbps over 4-wire unconditioned leased lines and is compatible with Codex CS48FP multipoint modems. This mode is intended for multipoint applications where compatibility with Codex CS48FP modems on the same lines is required.

The CS48FP mode is available only in the 2640 and the 2620 products. In the 2640, it should be used only when CS compatibility is required, and it may be used as a slave only with a Codex CS48FP as the master. In the 2620, this mode is recommended for all 4.8 and 2.4 kbps polling applications and may be mixed with Codex CS48FP modems without restriction. As in the MP mode, operation is asymmetrical and transmission rates are separately selectable in each direction. For CS48FP compatibility, the CS48FP modem must be configured for the 4800 bps polling mode for inbound and outbound directions. In addition, the CS48FP modem must select a control rate of 1, 2, 3, or 4 with A4/S3 Off and with the normal scrambler configuration.

The outbound direction is compatible with the Codex CS48FP modem. A 253 ms training sequence allows the modem to learn all significant channel characteristics. This mode recovers easily from short dropouts of 10 seconds or less without the need for a retrain, by retaining critical information on circuit equalization during these short line outages. TOD is supported by the 2620 and 2640 but not by the CS modems. Since TOD is supported by these modems, the "Cry for Help" feature found in the CS modems is not necessary for re-equalization. A Network Management System "train initiate" command can be used. In a mixed network with CS48FP modems as slaves, the 2620 is not recommended as the master because the CS48FP modem may disrupt the network with a "Cry for Help." Therefore, if the 2620 is the master, the CS48FP should be strapped so that the "Cry for Help" feature is disabled. In its place, the "train initiate" command may be used from Network Managment Systems. Without the Network Management System, there may be no way to retrain a CS48FP slave with a 2620 master except by powering down and powering back up.

The inbound direction is compatible with the Codex Gearshift mode. This mode uses a short (9 ms) training sequence to initially signal at 2.4 kbps and then shift up to 4.8 kbps. The 2.4/4.8 kbps Gearshift mode transmits data at 2.4 kbps for 64 bits and then shifts up to 4.8 kbps. Since some data terminals may not be able to accept the data and clock change from 2.4 to 4.8 kbps, a data buffer is always enabled to act as an interface between the DTE and the modem. This means that only 4.8 kbps data and clocks are seen at the EIA interface. See Figure 4-2 for an illustration of the buffers in block diagram form.

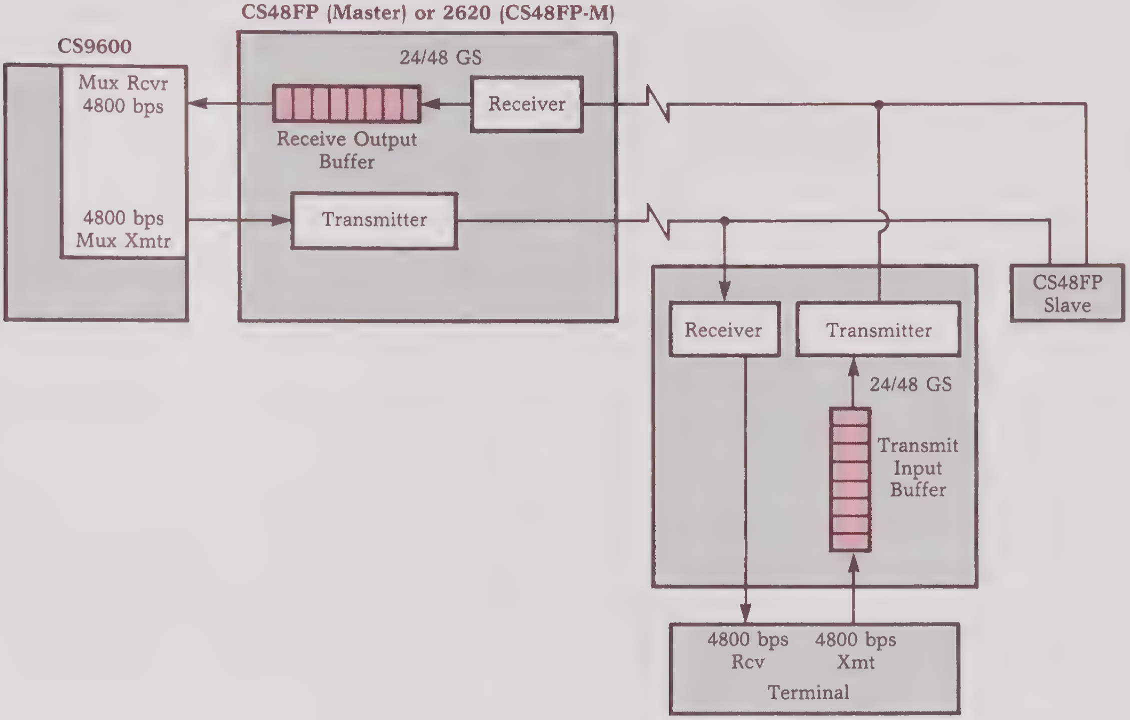

CS48FP (Master) or 2620 (CS48FP-M)
CS9600
24/48 GS
Mux Rcvr
4800 bps
Receive Output
Buffer
Receiver
4800 bps
Mux Xmtr
Transmitter
Receiver
Transmitter
CS48FP
Slave
24/48 GS
Transmit
Input
Buffer
4800 bps
Rcv
4800 bps
Xmt
Terminal

Figure 4-2. Multipoint System Showing Gearshift Compensation Buffers

V.27 *bis* Multipoint Mode

The V.27 *bis* master and slave modes allow operation at 4.8 and 2.4 kbps over unconditioned lines. The outbound direction uses the "long train" (708 ms at 4.8 kbps and 943 ms at 2.4 kbps), and the inbound direction uses the CCITT V.27-specified "short train" (50 ms at 4.8 kbps and 67 ms at 2.4 kbps). The V.27 multipoint modes are available only in the 2620 and, within this product, they are recommended for use when international V.27 compatibility is required in multipoint applications. At multipoint slaves, the MSU function can be used for "digital" bridging of multiple polled terminals.

The outbound "long train" allows the modem to learn all significant channel characteristics. The TOD technique is used when retraining is necessary. This mode recovers easily from short dropouts of 10 seconds or less without the need for a retrain by retaining critical information on circuit equalization during these short line outages.

The inbound "short train" allows fast poll response time for polling applications. No equalization recovery techniques are used on the inbound line.

Modem Sharing Feature

A built-in MSU capability allows you to share all of the modem's bandwidth on a single Time Division Multiplexer (TDM) channel. MSU capability is a feature of the multiplexer option and may be used in all of the modulation modes. The operation is equivalent to integration of one MSU into the modem. Each port configured for MSU operation receives the entire channel bandwidth and contends, via the RTS (Request To Send) signal, to transmit on the entire channel bandwidth allocated for MSU operation, as shown in Figure 4-3(A). When a port has been granted the channel, that port receives the CTS (Clear To Send) signal, and the CTS signals for all other ports assigned to the MSU are held inactive. When the active MSU port drops its RTS, the contention phase for the CTS signal begins again. ■ **Note:** Only one channel of the TDM (user-specified) can be defined for MSU operation.

Port-to-Channel Mapping

To configure the MSU it is necessary to differentiate between ports and channels. A port corresponds to the physical connector; a channel corresponds to the TDM time slot. Consequently, in an MSU, more than one port is associated with one channel, via the port-to-channel map (see Figure 4-3 for diagrams of port-to-channel mapping).

You are likely to use the MSU option when you have multiple colocated multipoint terminals. The three terminals that occupy ports assigned to the MSU, as shown in Figure 4-3(B), contend for the use of Channel 4. This contention procedure is accomplished through the RTS control signal, explained earlier under Modem Sharing Feature. Since only *one* terminal (port) can have the channel at any one time, the RTS signal generated by the DTE is used to request a channel.

This assignment of a channel as the MSU data channel is not necessary in the modem at the other end of the link because the normal application of an MSU is to have one port of the host in simultaneous communication with several terminals at a remote site.

RTS/DCD control signaling should not be enabled on the MSU data channel.

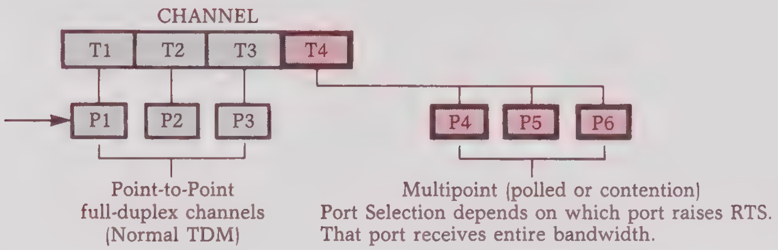
MULTIPOINT LOOPBACKS

Multipoint Loopbacks are similar to point-to-point loopbacks but are complicated by the following factors:

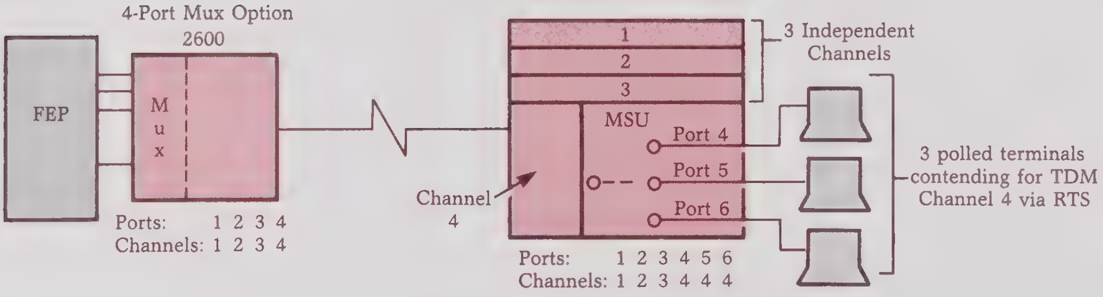
- End-to-end loopbacks can be done from the master only, through the slave, and back to the master. The test equipment must always be at the master site.
- The modems must be forced to operate symmetrically while in loopback (that is, cannot have different bit rates and modulation modes on the inbound and outbound links).

Terminal Loopback

Terminal Loopback operates independently in the master and each slave just as in point-to-point loopbacks. A slave in Terminal Loopback does not send trains or interfere with other slaves on the inbound line in any way (even if the test equipment raises RTS at the slave). See Figure 4-4.


CHANNEL
T1
T2
T3
T4
P1
P2
P3
P4
P5
P6
Point-to-Point
full-duplex channels
(Normal TDM)
Multipoint (polled or contention)
Port Selection depends on which port raises RTS.
That port receives entire bandwidth.

(A) Configuration of Channel Contention


4-Port Mux Option
2600
FEP
M
u
x
Ports: 1 2 3 4
Channels: 1 2 3 4
1
2
3
3 Independent
Channels
MSU
Port 4
Port 5
Port 6
Channel
4
Ports: 1 2 3 4 5 6
Channels: 1 2 3 4 4 4
3 polled terminals
contending for TDM
Channel 4 via RTS

(B) Mux/MSU Options

Figure 4-3. Mux/MSU Port-to-Channel Mapping

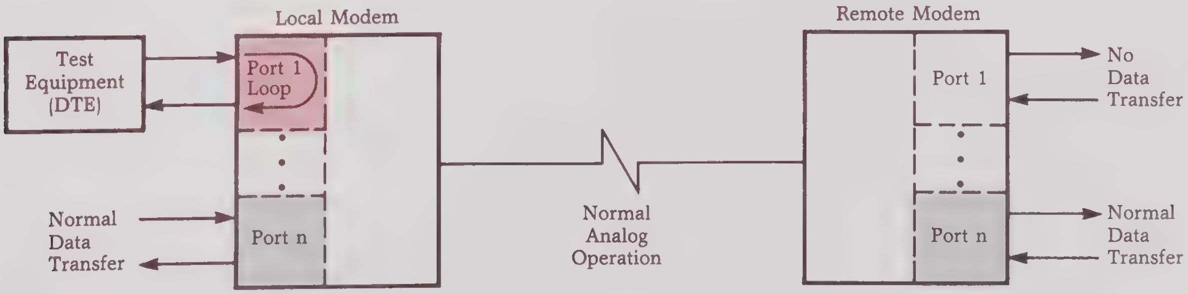

Local Modem
Test
Equipment
(DTE)
Port 1
Loop
Port n
Normal
Data
Transfer
Normal
Analog
Operation
Remote Modem
Port 1
Port n
No
Data
Transfer
Normal
Data
Transfer

Figure 4-4. Terminal Loopback on Port 1

Digital Loopback

Digital Loopback operates in the slave modem only and should be activated in only one slave modem at a time on a multipoint line. When any slave is in Digital Loopback, the master modem must also be put into Digital Loopback so that both modems can force symmetrical operation at both ends of the link under test. The other slaves will be out of service even though not involved in the test. See Figure 4-5.

Modem Check (Analog Loopback)

Modem Check operates independently in the master and each slave just as in point-to-point loopbacks. A slave in Modem Check does not send trains or interfere with other slaves on the inbound line in any way (even if the test equipment raises RTS at the slave). If you have no test equipment that is raising RTS at slaves in Modem Check, the Data Carrier Detect (DCD) and Receive Signal Quality (RSQ) indicators do not come on because the transmitter is not forced on by the Modem Check test. See Figure 4-6.

Audio Loopback

Audio Loopback operates in the slave modem only and on a multipoint line should be activated in only one slave modem at a time. When any slave is in Audio Loopback, the master modem must also be put into Audio Loopback so that both modems can force symmetrical operation at both ends of the link under test. The other slaves will be out of service even though not involved in the test.

Modem modulation modes are not guaranteed to pass data *through an audio loopback* with real channels or line blocks. Even though the audio loopback boosts the signal level to compensate for the double line attenuation, it does not compensate for the double amplitude and delay distortion that will usually prevent operating at greater than 7.2 kbps. Audio loopback is provided for use in special situations only. See Figure 4-7.

MULTIPOINT TESTS

Poll Test

The Poll Test is an end-to-end test that is most applicable for testing multipoint networks or for block error rate testing of point-to-point networks. In a Poll Test, the modems disconnect from the network; the master modem sends simulated polls to each slave, which then responds with a simulated poll in a ping-pong manner. The modems count the number of polls in error and the number of missing polls. When initiated from Network Management Systems, the test message lengths, slave address list, and number of polls per slave are operator-configurable. When initiated from the modem Control Panel, the test message is fixed as one "QUICK BROWN FOX". One slave is tested at a time, and the test is automatically run for 256 polls. Whether initiated by Network Management Systems or the modem Control Panel, the test always uses port 1 when run with the multiplexer option. ■ **Note:** The port number for the Poll Test is selectable by Network Management Systems but not from the 2600 Series Control Panel.

BER Test

The Bit Error Rate (BER) Test is an end-to-end test that can be used in a multipoint application with one slave, though it is most applicable for testing point-to-point networks (especially with multiplexer options). In a BER Test, the modems disconnect from the network, send a test pattern to each other, and count bit errors in the received test pattern. When initiated from Network Management Systems, the length of the test pattern as well as the test pattern are user-configurable. When initiated from the modem Control Panel, the test length is fixed as 10^6 bits and the test pattern character is "1010 1010". Whether initiated by Network Management Systems or the modem Control Panel, the port (channel) to be tested is user-configurable when run with a multiplexer option.

In order to properly perform a BER Test on a 2650 modem, you must set the modems to run at symmetrical rates or else configure the outbound speed as greater than the inbound speed. If you initiate a BER Test from a 2650 slave modem, first adjust your rate accordingly.

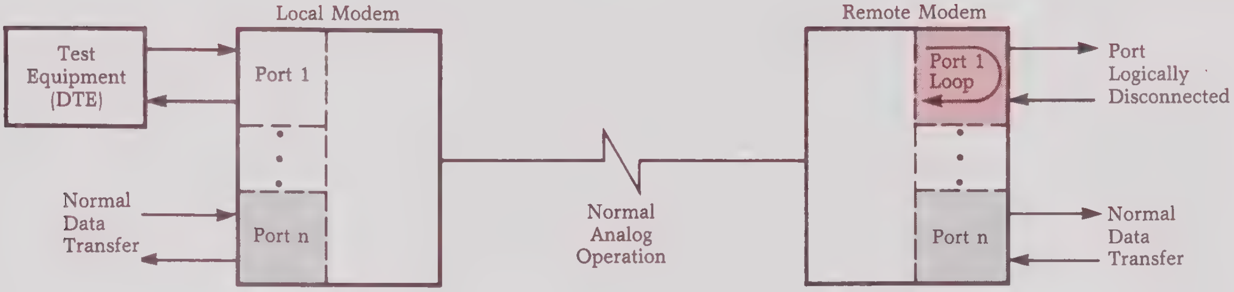

Local Modem
Test Equipment (DTE)
Port 1
Normal Data Transfer
Port n
Normal Analog Operation
Remote Modem
Port 1 Loop
Port Logically Disconnected
Port n
Normal Data Transfer

Figure 4-5. Digital Loopback on Port 1 (CCITT V.54, Loop 2)

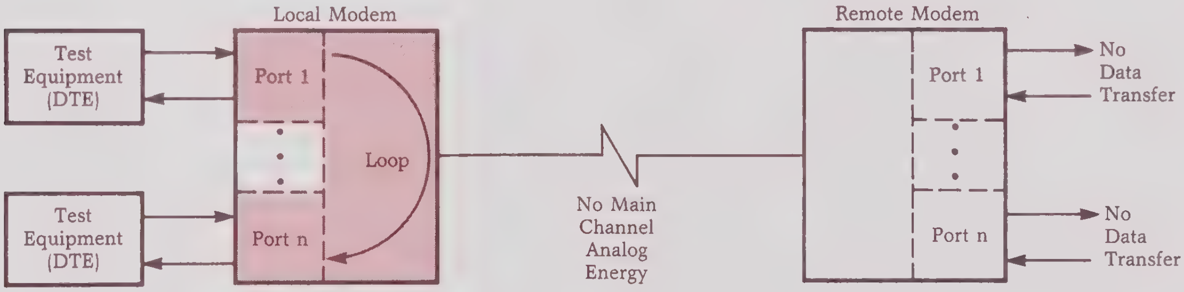

Local Modem
Test Equipment (DTE)
Port 1
Loop
Test Equipment (DTE)
Port n
No Main Channel Analog Energy
Remote Modem
Port 1
No Data Transfer
Port n
No Data Transfer

Figure 4-6. Modem Check

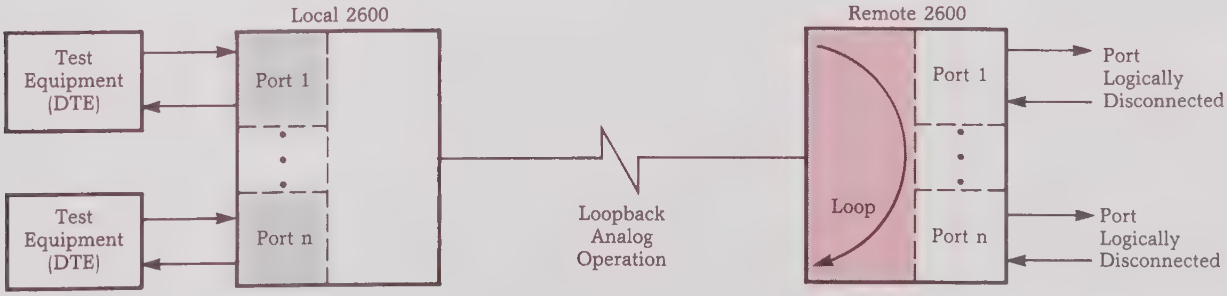

Local 2600
Test Equipment (DTE)
Port 1
Test Equipment (DTE)
Port n
Loopback Analog Operation
Remote 2600
Loop
Port 1
Port Logically Disconnected
Port n
Port Logically Disconnected

Figure 4-7. Audio Loopback

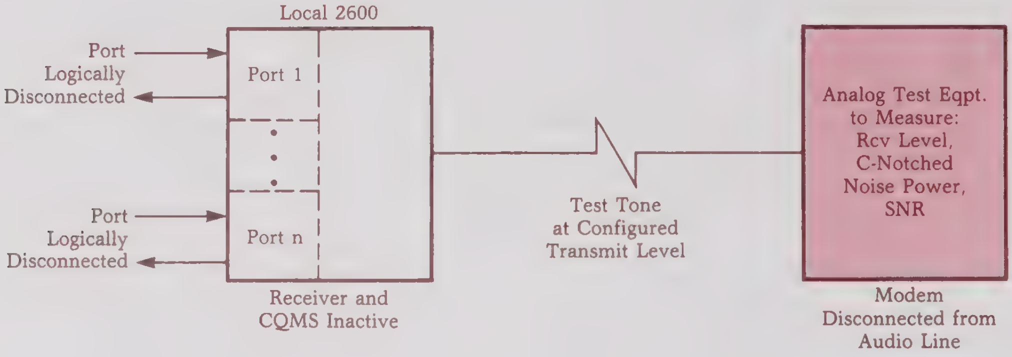

Local 2600
Port Logically Disconnected
Port 1
Port Logically Disconnected
Port n
Receiver and CQMS Inactive
Test Tone at Configured Transmit Level
Analog Test Eqpt. to Measure: Rcv Level, C-Notched Noise Power, SNR
Modem Disconnected from Audio Line

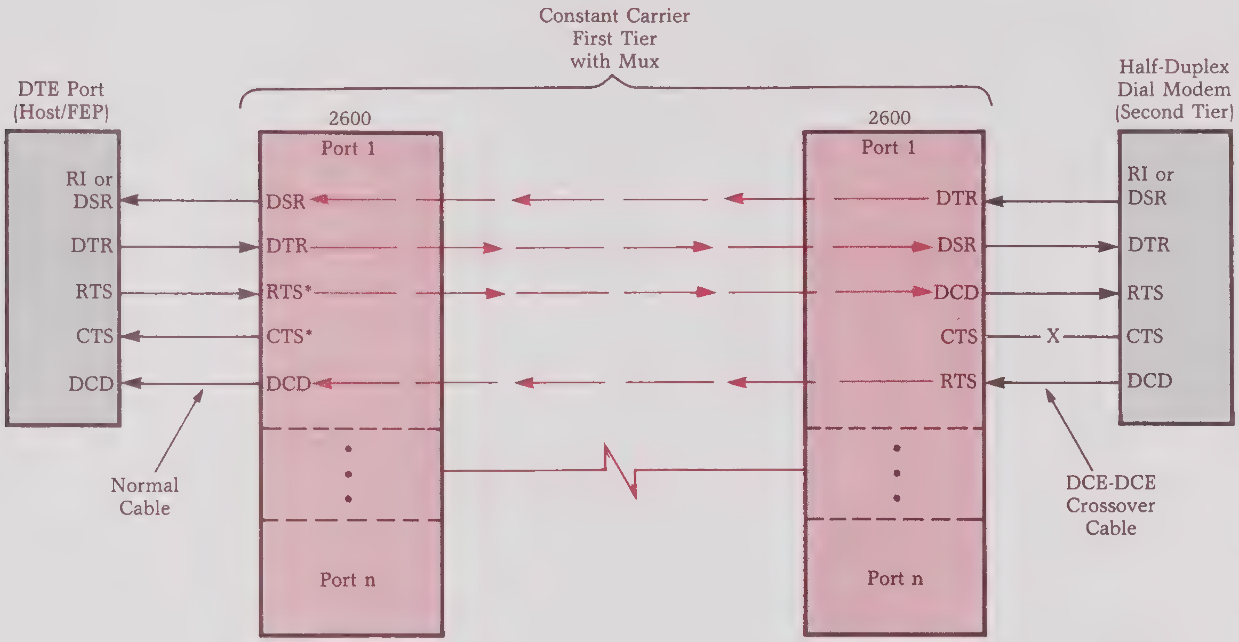
Figure 4-8. Test Tone

Self Test

The Self Test is a device test of the modem in which the modem disconnects itself from the network (including the network control channel) and internally loops test patterns through itself. It records any failures detected by identifying the board that appears to be faulty for service or repair. The Self Test can be initiated from Network Management Systems or the Control Panel. When initiated from Network Management Systems, the test is executed once only. When initiated from the modem Control Panel, the test can be executed once only (default) or can be run continuously. The latter can be activated and cancelled locally only and not via the remote Control Panel feature.

Test Tone

In multipoint applications, the Test Tone operates in the same way as in point-to-point except that the test to generate the 1004 Hz tone should be activated from only one slave at a time when performing analog tests on the inbound link(s). When activated at the master, analog tests on the outbound link(s) can be performed simultaneously at any or all slave sites. The other slaves will be out of service even though not involved in the test (see Figure 4-8). ■ **Note:** The receiver and CQMS are disabled while generating the Test Tone. The remote modem, if left connected, cannot display valid CQMS data for a Test Tone.


Constant Carrier
First Tier
with Mux
DTE Port
(Host/FEP)
RI or
DSR
DTR
RTS
CTS
DCD
2600
Port 1
DSR
DTR
RTS*
CTS*
DCD
Port n
2600
Port 1
DTR
DSR
DCD
CTS
RTS
Port n
Half-Duplex
Dial Modem
(Second Tier)
RI or
DSR
DTR
RTS
CTS
DCD
X
Normal
Cable
DCE-DCE
Crossover
Cable

*A port RTS-CTS delay must be selected here to allow sufficient time for the half-duplex tail circuit to train and be ready to transmit the data passed through the first tier.

X = No Connection

■**Note:** 2600 Series Modems do not have a ring indicator; however, a ring indicator is present on half-duplex dial modems and front-end ports.

Figure 4-9. Control Signaling

Special Control Signal Handling in Loopbacks and Tests

The use of loopbacks and tests generally causes EIA/CCITT control signals to be turned Off because the function that they normally represent is disabled by the test condition. However, some DTEs interact poorly with a modem that turns off EIA/CCITT control signals during tests (such as logging the line off, refusing to execute loop testing, or requiring a Front End reboot to re-enable the line). Three port straps can override the effects of loopbacks on the handling of EIA/CCITT control signals (see Chapter 2). (They also override the normal operation of the EIA/CCITT control signals in response to other modem or link conditions.) See Figure 4-9.

- ***DCD Always On:*** This strap leaves DCD On during all test conditions or dropouts even if the test normally turns DCD Off.
- ***CTS Follows RTS:*** This strap always returns CTS in response to RTS even if a test condition normally keeps CTS Off.
- ***DSR Always On:*** This strap keeps DSR On during all test conditions even if the test normally turns DSR Off.

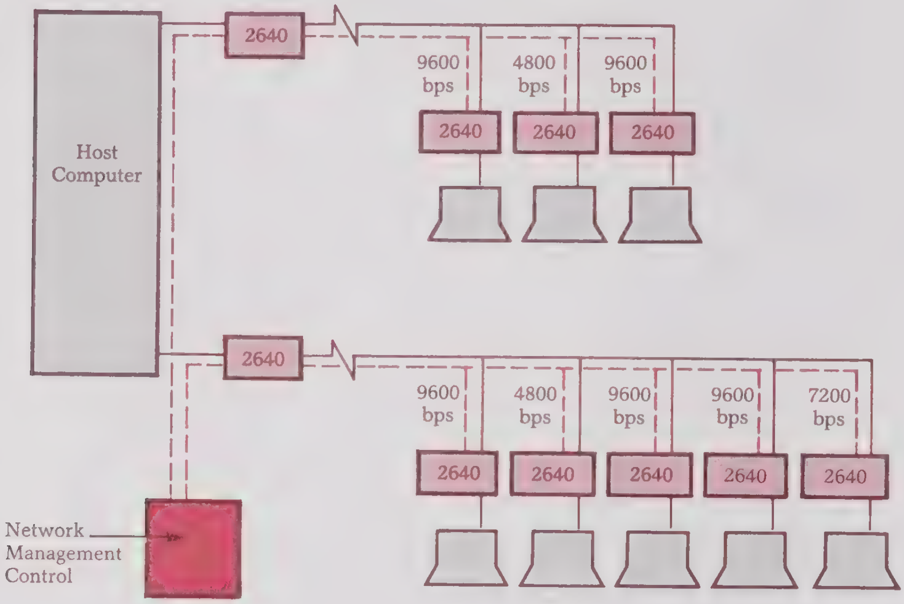


Figure 4-10. 2640 Modem and Network Management Systems

APPLICATIONS

2640 Modem and Network Management Systems

Wilson Cooperative Bank is a full service financial institution headquartered in CPU City, South Dakota, with branches throughout the plains states. Each branch is tied into the main Wilson Cooperative computer through multipoint lines. Unfortunately, weak links are bringing down an entire chain. When certain drops fall back to maintain reliable inbound transmission, the entire multipoint line falls back to the speed of the slowest drop. The result is slower response time, reduced throughput, and restless customers.

Stephen Raines, the bank's data communications specialist, has determined that the Codex 2640 Modem provides the best solution to Wilson Cooperative Bank's problem. Codex 2640 Modems represent a major breakthrough for optimizing throughput in multipoint environments. Using Network Management Systems, the MSQB function individually tracks inbound performance for as many as 15 remote modems (see Figure 4-10).

When multipoint signal quality degrades for a particular drop, Wilson Cooperative can activate the MIR feature, which allows the Codex 2640 master modem to operate with each slave modem transmitter at a different inbound rate. In this way, a poor performer does not affect the efficiency of the entire multipoint network.

The Codex 2640 TOD feature further improves throughput over multipoint networks by eliminating time-consuming retrains in the outbound direction. TOD permits individual slave modems to train on transmitted data, rather than disrupt the entire multipoint line with a CFH when synchronization is lost. Stephen Raines is confident that the Codex 2640 modems will help keep Wilson Cooperative Bank's coffers full.

2650 Modem High-Speed Advantage

As an up-and-coming telemarketing firm, Sorel-Tel believed that purchase of an advanced software package is the best way to simplify its methods of processing telephone communications data. The firm had originally installed a traditional 9600 bps multi-

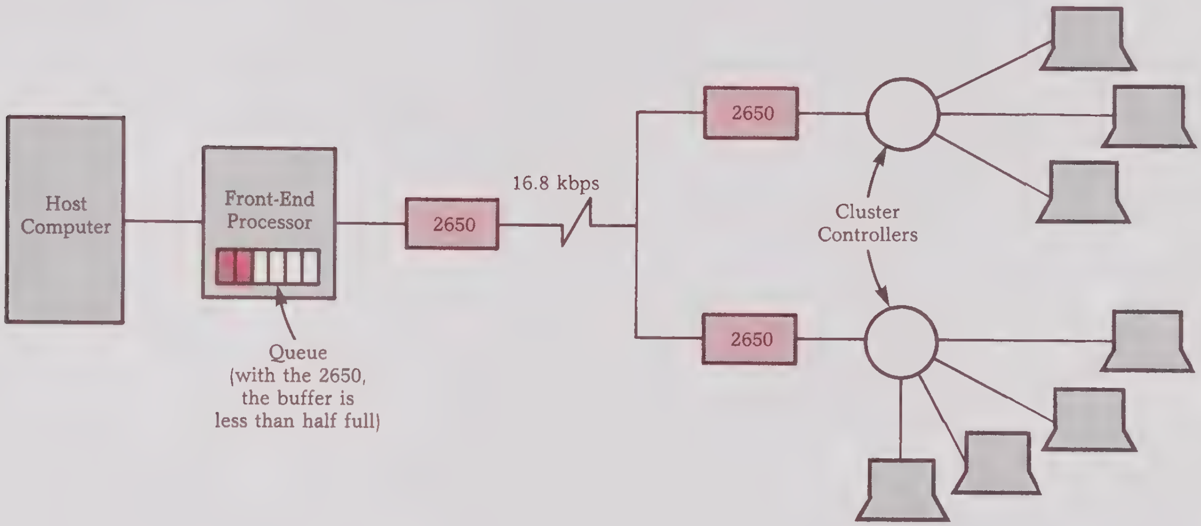


Figure 4-11. 2650 Modem High-Speed Advantage

point system that transmitted all received data to the central computer for processing. However, the new software would allow operators at various terminals to preview the data much more efficiently; it provided menu-driven screens so that the operators could select only the relevant material for transmission.

In the past, Sorel-Tel's remote terminal operators keyed in everything a customer said in a telemarketing conference. With the new software, operators could tab easily from field to field of data on a screen and fill in only those areas to which the customer responded. This change doubled the number of transactions Sorel-Tel operators could perform. In addition, operators could locate background or historical information from a central database in order to respond adequately to consumer inquiries.

The problem that emerged, not surprisingly, was that the existing multipoint lines worked very well on the inbound route, but the system in the outbound direction was bottlenecked! The queue buffer of outbound messages in the FEP was over capacity. The length of this queue and the time for a new message to get to the front of the queue are affected very strongly by the speed of the outbound link; response time for Sorel-Tel communications was seriously impaired. Because the new software required extensive outbound data to transmit advanced graphics, displays, and data base information to remote DTEs, the standard 9600 bps outbound rate on which Sorel-Tel functioned became a liability. The data was available—it just couldn't be pulled across the comunication lines fast enough. The added outbound traffic slowed everything to a crawl; the cost of operating the system increased along with user complaints.

Sorel-Tel investigated means of upgrading the multipoint system to accommodate the new software. The company found that a high-speed multipoint system would alleviate the core problem of excessive queueing in the FEP. The Codex 2650 High-Speed Multipoint Modem—operating at speeds of 14.4 kbps and 16.8 kbps—made the difference. The firm replaced its old system with 2650 modems. Rapidly, the response time to remote terminals was significantly reduced, as shown in Figure 4-11. Sorel-Tel was then able to conduct its surveys and respond to customers without critical delays or downtime interruptions.

CODEX

2630 Modem
User's Manual

CODEX

2630 Modem User's Manual

Notice

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User Questionnaire

A prepaid user questionnaire is provided in the back of this manual for your comments. Codex welcomes your comments; your input is important in helping us improve the effectiveness of this manual. Thank you.

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

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MOTOROLA

Contents

Chapter 1. Features and Operation

General 1-1
Product Features 1-2
Operating Modes 1-2
MPMUX Modes 1-6
  Inbound Transmission 1-6
  Outbound Transmission 1-6
  Timing 1-11
MUX 1✳ and MUX 2✳ Categories 1-12
CQMS and MSQB 1-12
MSU 1-12
Asynchronous Terminal Support 1-12
  Async-to-Sync Conversion 1-12
  Synchronous Oversampling (Coarse Sampling) 1-12
Loopbacks and Tests 1-13
Network Management Systems Interface 1-14
Specific 2630 Features: Summary 1-14

Chapter 2. Application Example

2630 Modem Advantage 2-1

Chapter 1
Features and Operation

Contents

General 1-1
Product Features 1-2
Operating Modes 1-2
MPMUX Modes 1-6
  Inbound Transmission 1-6
  Outbound Transmission 1-6
  Timing 1-11
MUX 1✳ and MUX 2✳ Categories 1-12
CQMS and MSQB 1-12
MSU 1-12
Asynchronous Terminal Support 1-12
  Async-to-Sync Conversion 1-12
  Synchronous Oversampling
    (Coarse Sampling) 1-12
Loopbacks and Tests 1-13
Network Management Systems Interface 1-14
Specific 2630 Features: Summary 1-14

GENERAL

The Codex 2630 Dual Multipoint Modem gives you the advantage of using two independent applications over one multipoint line, providing you with significant line savings and flexibility in the design and operation of your communications network. Along with the broad array of features common to the 2600 Series Modem family, the 2630 combines both synchronous and/or asynchronous multipoint protocols at inbound rates of 2400 and 4800 bps.

PRODUCT FEATURES

All the standard features of the 2600 Series Modems in the following list are available on the 2630 Dual Multipoint Modem. For general information on these features, refer to the *2600 Series User's Manual.*

- Control Panel (with Remote Capability)
- Network Management Systems
- Network Management Systems Control Channel
- Circuit Quality Monitoring System (CQMS)
- Multipoint Signal Quality Binning (MSQB)
- Mixed Inbound Rate (MIR)
- Eye Pattern Generator (EPG)
- Power-Up Self Test
- Data Handling: Sync; Async, 6 to 9 bits; Isoc
- Multiport Option: 4 DTE Ports, 2- to 4-port MSU;
  6 DTE Ports, 2- to 6-port MSU
- Audio Features: Domestic 4-wire leased; 3002
- Dual Dial Restoral (DDR)
- Power Fail Alarm
- Communications Test Equipment (CTE)

OPERATING MODES

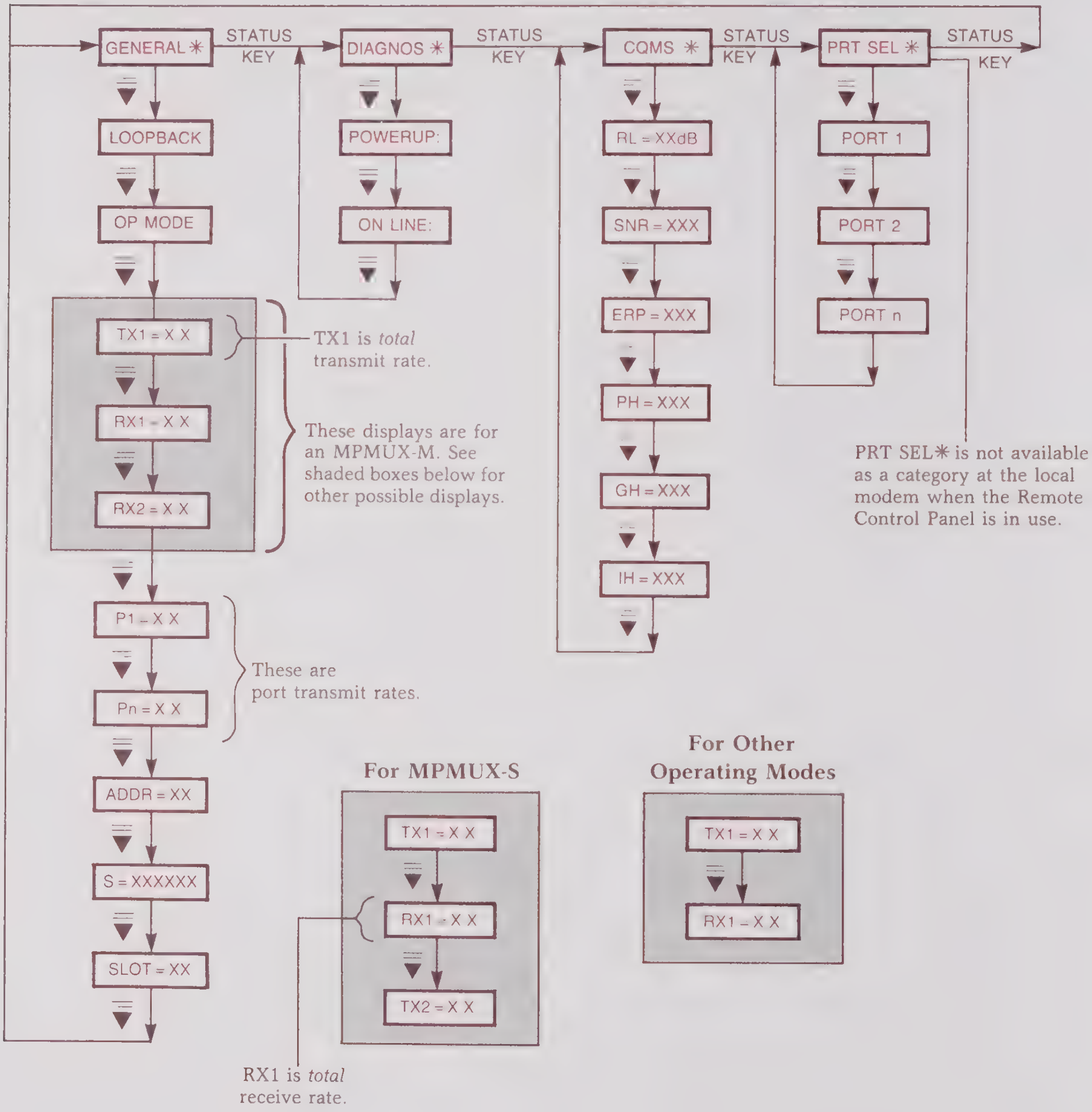
The 2630 Dual Multipoint Modem has three modes of operation: MPMUX, MP, and PP/CI. Table 1-1 summarizes these modes.

The MPMUX operating mode allows operation of two independent inbound applications simultaneously over the same multipoint line. The second mode, MP, is a single-channel mode that is compatible (in fallback only) with the 2640 Modem at 4800 bps. This mode is intended for applications when 2-channel operation is not required, or when improved performance over one channel is required. The third mode, PP/CI, is used in point-to-point applications for 4800 bps operation. A 2-channel buffered multiplexer is provided as a standard feature for point-to-point operation.

Table 1-1.
2630 Operating Modes

Operating Mode	*Data Rate (kbps)*	*Transmit Carrier*	*Telephone Line Requirements*	*Training Time (ms)*	*Equalization Recovery Method*
MPMUX-M	9.6 7.2	Constant	3002	253	N/A
MPMUX-S					
Channel 1:	4.8 2.4 1.2	Controlled	3002	20	Cry For Help
Channel 2:	2.4 1.8 1.2				
MP-M	4.8	Constant	3002	248	Train On Data
MP-S	4.8	Controlled	3002	17	Train On Data
PP/CI	4.8	Constant	3002	253	Round Robin (1 to 2 sec)

STATUS TREE


GENERAL ✳
STATUS KEY
DIAGNOS ✳
STATUS KEY
CQMS ✳
STATUS KEY
PRT SEL ✳
STATUS KEY
LOOPBACK
OP MODE
TX1 = X X
RX1 = X X
RX2 = X X
P1 = X X
Pn = X X
ADDR = XX
S = XXXXXX
SLOT = XX
POWERUP:
ON LINE:
RL = XXdB
SNR = XXX
ERP = XXX
PH = XXX
GH = XXX
IH = XXX
PORT 1
PORT 2
PORT n
For MPMUX-S
TX1 = X X
RX1 = X X
TX2 = X X
For Other Operating Modes
TX1 = X X
RX1 = X X

TX1 is *total* transmit rate.

These displays are for an MPMUX-M. See shaded boxes below for other possible displays.

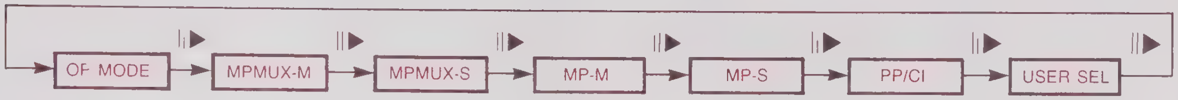
These are port transmit rates.

PRT SEL✳ is not available as a category at the local modem when the Remote Control Panel is in use.

RX1 is *total* receive rate.

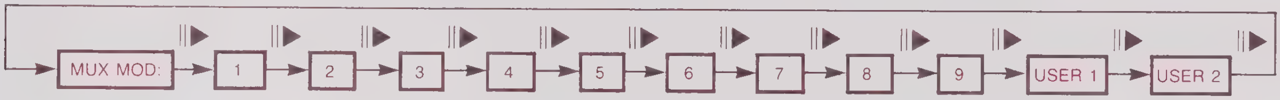
CONFIGURATION TREE

OP MODE:

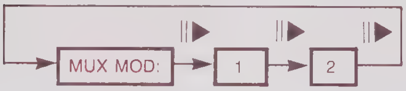

OP MODE
MPMUX-M
MPMUX-S
MP-M
MP-S
PP/CI
USER SEL

MUX MOD:

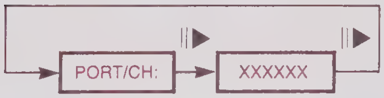
For MPMUX-M, MPMUX-S, and USER SEL operating modes:


MUX MOD:
1
2
3
4
5
6
7
8
9
USER 1
USER 2

For PP/CI operating mode:



PORT/CH


PORT/CH:
XXXXXX

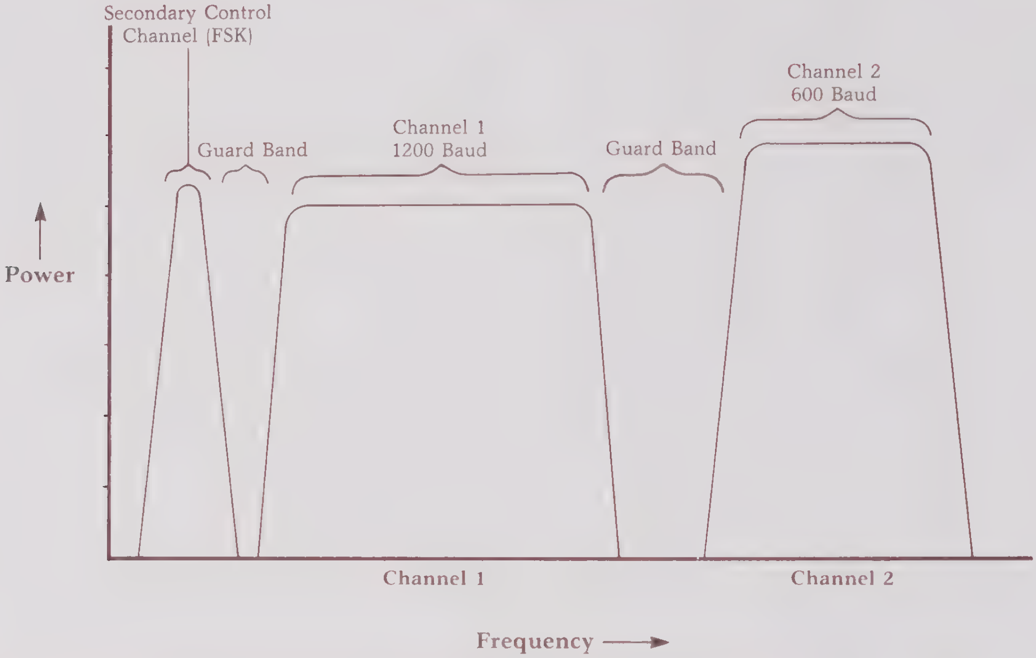


Figure 1-1. Frequency Division Multiplexing

MPMUX MODES

In the MPMUX-M and MPMUX-S modes, the 2630 Modem operates with a maximum aggregate outbound rate of 9600 bps. The modem has a maximum inbound rate of 4800/2400 bps on the two inbound channels. Operation of these channels is described in the following sections.

Inbound Transmission

The inbound communications line is split into two frequency division multiplexed channels, Channels 1 and 2, to accommodate the line sharing for two front end processors (FEPs). Each channel has its own independent carrier control. Thus, at the slave modem, the DTE for one application on port 1 controls the carrier for one of the two FDM channels; the DTE for the application on port 2 controls the carrier for the second FDM channel. Network commands for 2630 operation are carried over the usual FSK bandwidth available on 2600 Modems (see Figure 1-1.)

Each channel on the 2630 has an inbound training time of less than 20 ms. The Mixed Inbound Rate (MIR) feature is always enabled in the MPMUX operating mode. You can independently configure the inbound rate for Channels 1 and 2 at each slave. MIR is only recommended for synchronous applications.*

Outbound Transmission

While the inbound transmission requires a Frequency Division Multiplexing (FDM) technique to avoid collision of the two independent channels in the MPMUX operating mode, the outbound link uses the typical Time Division Multiplexing (TDM) technique. Therefore, it is possible to configure a third "broadcast only" simplex channel, Channel 3, on the outbound link, in addition to the outbound Channels 1 and 2.

---

* For the MP-M and MP-S operating modes, equalization recovery is accomplished through the Train On Data (TOD) technique. The slave modem recovers synchronization by reading the data sequence sent by the master modem, without disrupting transmission on any other modem.

Multiplexing on the outbound channel must be synchronized, and therefore slave modems must get a retrain from the master modem via a Cry For Help (CFH) instead of the Train On Data (TOD) method used in the MP-M and MP-S modes (see Table 1-1). With the CFH function, a slave that has lost equalization requests a retrain from the master. The CFH signal is sent on Channel 2, and this short signal on the inbound line is detected by the master receiver as something different from a normal inbound training sequence. The master receiver then signals the transmitter to send a retrain to all slaves.

This operation disrupts only inbound Channel 2 until the retrain occurs; however, after 10 seconds, the frequency of CFH drops to once in every 40 seconds. This minimizes disruption and allows polling to continue; thus, a modem that cannot acquire synchronization on the outbound line will not bring down the whole multipoint line. ■ **Note:** Both channels will be interrupted by the outbound retrain of the master modem. As with any equalization recovery method, you can disable the CFH. See Modem Strap 02✳ on the Configuration Tree in the *2600 Series User's Manual.*

You can set the outbound modulation modes according to standard 2600 Series configurations. However, for MPMUX operating modes, you need to configure the outbound rate for both master and slave modems because the outbound modulation mode does not signal mux configurations in the training sequence.

As Table 1-2 shows, there is also a ''broadcast only'' channel available in the outbound direction. This allows the transmission of data for applications.

See Tables 1-2, 1-3, and 1-4 for mux modes.

Table 1-2.
Outbound Mux Modes

Mux Mode	*Channel*	*7.2*	*9.6*
1	1	4.8	7.2
	2	2.4	2.4
2	1	4.8	7.2
	2	1.8	1.8
3	1	4.8	7.2
	2	1.2	1.2
4	1	4.8	4.8
	2	2.4	4.8
5	1	4.8	4.8
	2	2.4	4.8
6	1	4.8	7.2
	2	1.8	1.8
	3	0.6*	0.6*
7	1	4.8	7.2
	2	1.2	1.2
	3	1.2*	1.2*
8	1	4.8	4.8
	2	2.4	2.4
	3	—	2.4*
9	1	4.8	4.8
	2	2.4	2.4
	3	—	2.4*

* This channel is for ''broadcast only'' (simplex). This feature is available only on units with more than two ports.

Table 1-3.
Inbound Mux Modes

Channel	*Bit Rate**	*Baud Rate*	*Training Time*
Channel 1			
Primary	4.8	1200	20 ms
Fallback	2.4	1200	20 ms
Fallback	1.2	1200	20 ms
Channel 2			
Primary	2.4	600	20 ms
Fallback	1.8	600	20 ms
Fallback	1.2	600	20 ms

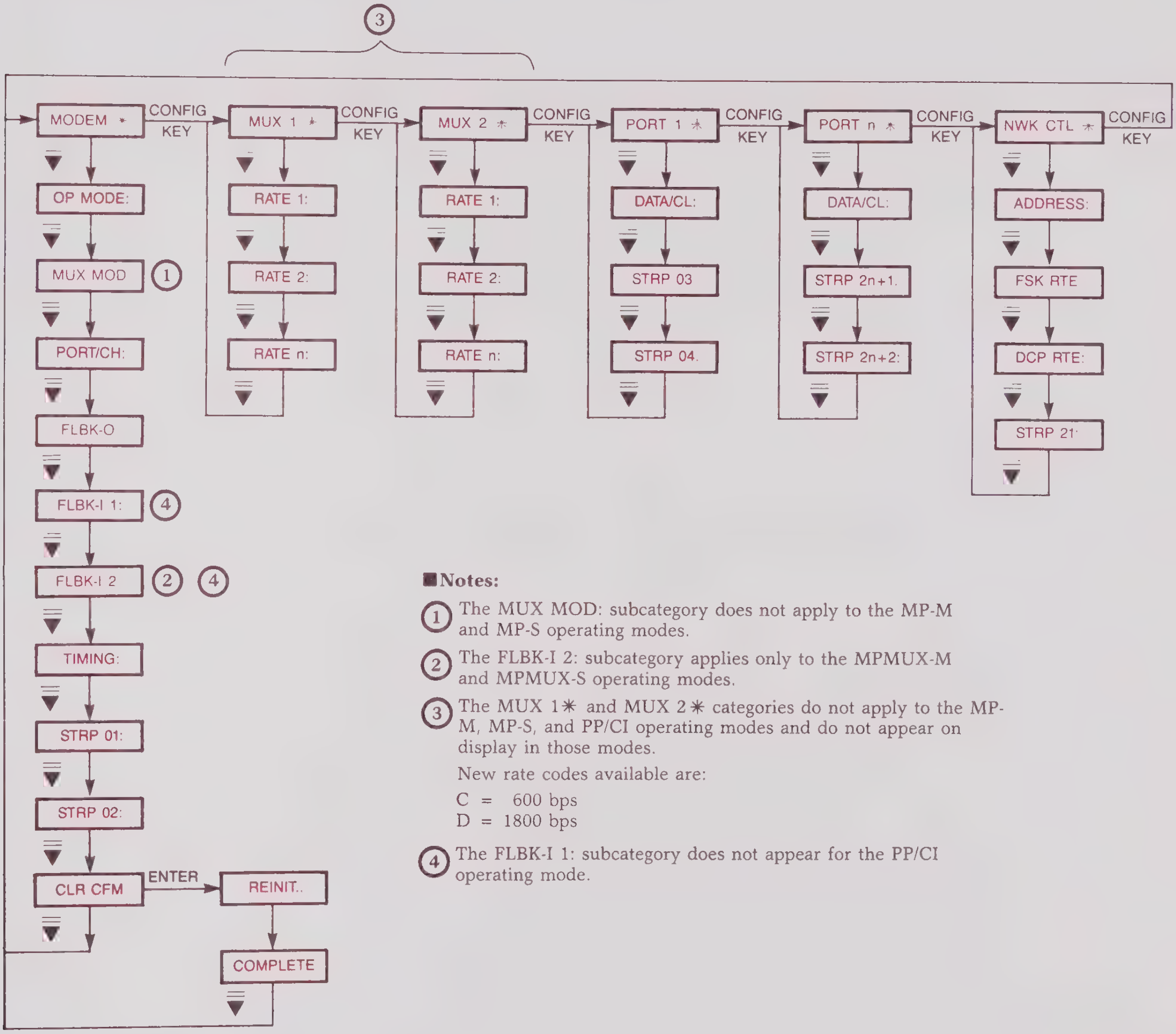
* Any channel can be configured for async-to-sync conversion to support an asynchronous application, but asynchronous DTEs normally require symmetrical bit rates. The outbound channel rate assigned should be equal to the inbound rate for asynchronous applications.

Any asynchronous application at 300 bps or less can be handled by synchronous sampling at 1200 or 2400 bps.

Table 1-4.
PP/CI Mux Modes

Mux Mode	*Channel*	*Channel Rate (4.8)*
1	1	4.8
	2	—
2	1	2.4
	2	2.4

CONFIGURATION TREE


③
MODEM ✳
CONFIG KEY
MUX 1 ✳
CONFIG KEY
MUX 2 ✳
CONFIG KEY
PORT 1 ✳
CONFIG KEY
PORT n ✳
CONFIG KEY
NWK CTL ✳
CONFIG KEY
OP MODE:
MUX MOD
①
PORT/CH:
FLBK-O
FLBK-I 1:
④
FLBK-I 2
②
④
TIMING:
STRP 01:
STRP 02:
CLR CFM
ENTER
REINIT..
COMPLETE
RATE 1:
RATE 2:
RATE n:
RATE 1:
RATE 2:
RATE n:
DATA/CL:
STRP 03
STRP 04.
DATA/CL:
STRP 2n+1.
STRP 2n+2:
ADDRESS:
FSK RTE
DCP RTE:
STRP 21:

■**Notes:**

① The MUX MOD: subcategory does not apply to the MP-M and MP-S operating modes.

② The FLBK-I 2: subcategory applies only to the MPMUX-M and MPMUX-S operating modes.

③ The MUX 1✳ and MUX 2✳ categories do not apply to the MP-M, MP-S, and PP/CI operating modes and do not appear on display in those modes.

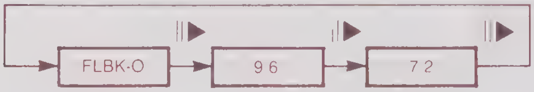
New rate codes available are:

C = 600 bps
D = 1800 bps

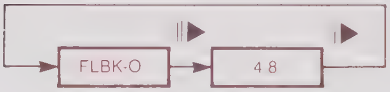
④ The FLBK-I 1: subcategory does not appear for the PP/CI operating mode.

FLBK-O:

For MPMUX-M and MPMUX-S operating modes:

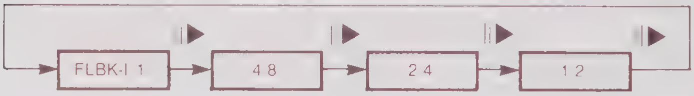


For MP-M, MP-S, and PP CI operating modes:

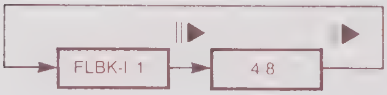


FLBK-I 1:

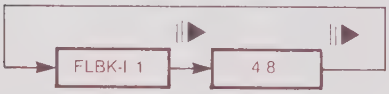
For MPMUX-M and MPMUX-S operating modes:


FLBK-I 1
4 8
2 4
1 2

For MP-M operating mode:



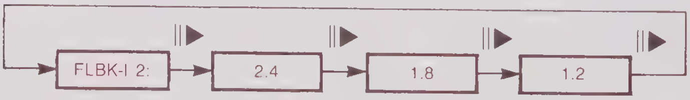
For MP-S operating mode:



■ **Note:** FLBK-I 1: is not available with the PP/CI operating mode.

FLBK-I 2:

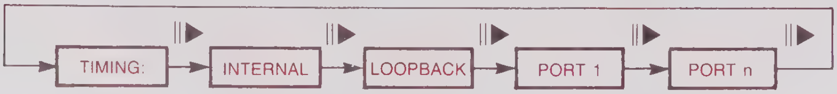
For MPMUX-M and MPMUX-S operating modes:


FLBK-I 2:
2.4
1.8
1.2

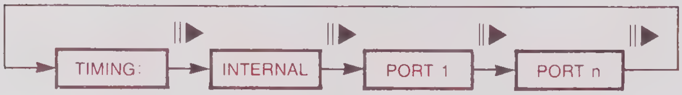
■ **Note:** FLBK-I 2: is not applicable to the MP-M, MP-S, PP/CI, and USER SEL operating modes.

TIMING:

For all operating modes except MPMUX-M and MPMUX-S:



For MPMUX-M:



■ **Note:** *No* timing subcategory will appear on display for the MPMUX-S operating mode, which functions exclusively with loopback timing.

Timing

When you use the MPMUX operating modes, the Dual Multipoint master modems use either internal or external timing (*not* loopback timing). Dual Multipoint slave modems use loopback timing exclusively. You must assign port 1 a rate of *at least 4800 bps* on the outbound line to implement the timing sequence. (Assigning less than 4800 bps to port 1 via port-to-channel mapping is also not permitted.)

While slaves will always operate in loopback timing, port timing can still be specified to allow data to be clocked in with an externally supplied clock. There is a buffer to absorb minor frequency differences. However, if the clock drifts significantly, the buffer within the modem could overflow.

Port timing in the slave and master sites can be selected as either sync internal, sync external, or async. If you have a multipoint tail circuit that is supported via a 2630, the second tier slaves will operate in loopback timing while the second tier master accepts and tracks the MPMUX slave receive clock. In this case, you would need to configure the slave port on the MPMUX to ''sync external''; this allows the modem to clock in data from the second tier master receiver. Frequency lock is achieved since the second tier slaves are in loopback timing.

MUX 1 ✳ AND MUX 2✳ CATEGORIES

The MUX 1✳ and MUX 2✳ Categories allow you to customize your mux configurations. See the *2600 Series User's Manual* for more information on these features.

As explained in the previous section, you *must* configure port 1 on the outbound at a rate greater than 4800 bps. MUX 1✳ and MUX 2✳ Categories are available for the MPMUX operating modes only.

CQMS AND MSQB

The continuous Circuit Quality Monitoring System (CQMS) parameters standard to 2600 Series Modems are supported at the slave receiver in the 2630. Continuous parameters on the outbound lines can always be obtained at the slave. However, the constant carrier CQMS parameter is *not* supported on the inbound channel. If you want to have CQMS continuous parameters for the inbound, you can only obtain that data on the outbound modulation mode from one slave (e.g., digital loopback).

Multipoint Signal Quality Binning (MSQB) information is supported in the inbound direction. You can always obtain this data on Channel 1 of the inbound line. ■ **Note:** The signal quality LED will reflect the quality of Channel 1 on the inbound *only.*

Depending on the type of line in use and because of attenuation differences on each frequency band, the MPMUX operating mode carrier detect thresholds are somewhat different from the usual 2600 product. These thresholds are determined by measuring the actual receive signal energy of each channel, when the other channel signal is off. The carrier detect thresholds measured in this fashion for the 2630 are as follows:

	On	*Off*
1200 baud mode	−27 dBm	−34 dBm
600 baud mode	−29 dBm	−38 dBm

MSU

The 2630 has two ports standard. For MSU operations at the slave site, both 4- and 6-port units are available. Note that this MSU feature is supported for *both* channels in the 2630. However, this is true only when the modem is in the MPMUX modes. When you are operating in the PP/CI or MP modes, only one MSU will be available.

ASYNCHRONOUS TERMINAL SUPPORT

Two methods are available in 2600 Series Modems for asynchronous applications: async-to-sync conversion or synchronous oversampling.

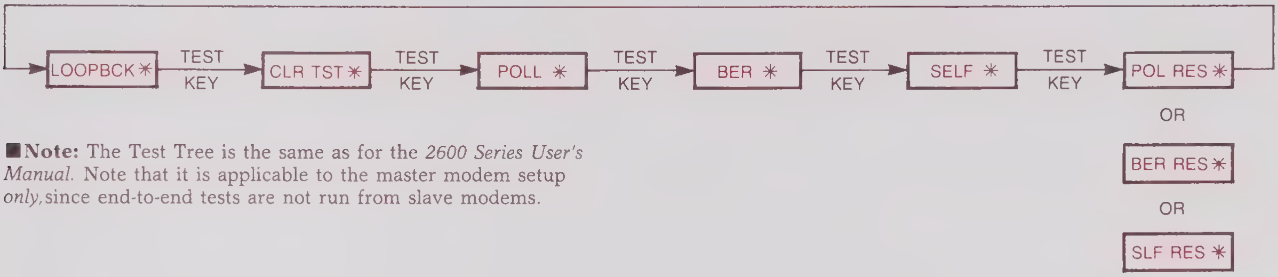
Async-to-Sync Conversion

You configure this feature on a port-by-port basis to support asynchronous multipoint DTEs on either or both channels. Generally you set the bit rate and character length, and ensure that the rates are consistent with the transmitter setting. Then you configure the modem ports for the same bit rate and character length as you have set for the DTEs. The character length in the modem equals bits per character plus parity. The port outbound rate is determined by the modem outbound rate and mux mode; this must be equal to the inbound rate, as it is determined by the operating mode and inbound rate selected on the channel.

Synchronous Oversampling (Coarse Sampling)

You cannot configure the 2630 port for async-to-sync conversion at speeds lower than 1200 bps. However, by using synchronous oversampling, you can use a 1200 or 2400 bps synchronous channel to transmit from 0 to 600 bps asynchronous data, without requiring async-to-sync conversion (see Table 1-3).

TEST TREE



■ **Note:** The Test Tree is the same as for the *2600 Series User's Manual.* Note that it is applicable to the master modem setup *only,* since end-to-end tests are not run from slave modems.

LOOPBACKS AND TESTS

The Poll and BER Tests standard to 2600 Series Modems are supported for the 2630 on the master modem only for Channels 1 and 2. (Channel 3, the simplex channel, does not support these tests.) You can run these tests on either channel without affecting the operations of the other. Also, since the Poll and BER Tests of the 2630 can be run only on ports that have active inbound and outbound channels, you must ensure that the master and slave modems have the same port-to-channel mapping.

Multipoint loops, such as Digital Loopback and Audio Loopback, are controlled from the central site, and the outbound data is looped through the slave to the master only.

For all loopback testing, the 2630 Modem will force symmetrical operation by using the *outbound* modulation mode. In the case of all loopbacks, testing must be performed on both modems at once, because the master modem forces symmetry and the slave modem forces symmetry *and* loopback. Since the outbound modulation mode and rate are forced during digital loops, the port rates at the slave modem will change during the loopback. The mux modes on the master and slave modems have to be the same in order to run the digital loopback. Normal conditions are restored after the loopback is terminated.

NETWORK MANAGEMENT SYSTEMS INTERFACE

The Network Management Systems interface functions in much the same way as the DTE interface described in Chapter 1 of the *2600 Series Modem User's Manual.*

SPECIFIC 2630 FEATURES: SUMMARY

This guide has described in detail only those features and operations specific to the 2630 Dual Multipoint Modem. When you are configuring and interpreting data from a 2630, remember that the results will differ from standard 2600 Modem operation in ways that were discussed earlier in this guide. The following list highlights some of these aspects:

- Two independent channel applications operate simultaneously on an inbound multipoint line.
- Separate fallback rates are present on inbound channels.
- A third, ''broadcast only,'' channel exists on the outbound (simplex).
- Unique carrier thresholds are used.
- 2640 modulation mode is available on the outbound.
- Port 1 rate must be at 4800 bps or greater.
- Digital Loopback and Modem Check on either the MPMUX Master or MPMUX Slave forces the outbound modulation mode; therefore, port rates will depend on the MUX MOD: and FLBK-O: rates.
- Signal Quality LED reflects only the quality of Channel 1 on the inbound.
- Additional transmit rate displays are on the Control Panel.
- Poll/BER Tests apply to Channels 1 and 2 only.
- Slave modems operate in loopback timing only.
- Master modem cannot operate in loopback timing.
- The EPG on the master modem will show the 1200 bps channel only.
- Carrier detect threshold strap selections are not applicable in the master modem.
- MIR is always enabled, and the inbound rates are determined by the configured rate of the slave.

Chapter 2
Application Example

Contents

2630 Modem Advantage 2-1

2630 MODEM ADVANTAGE

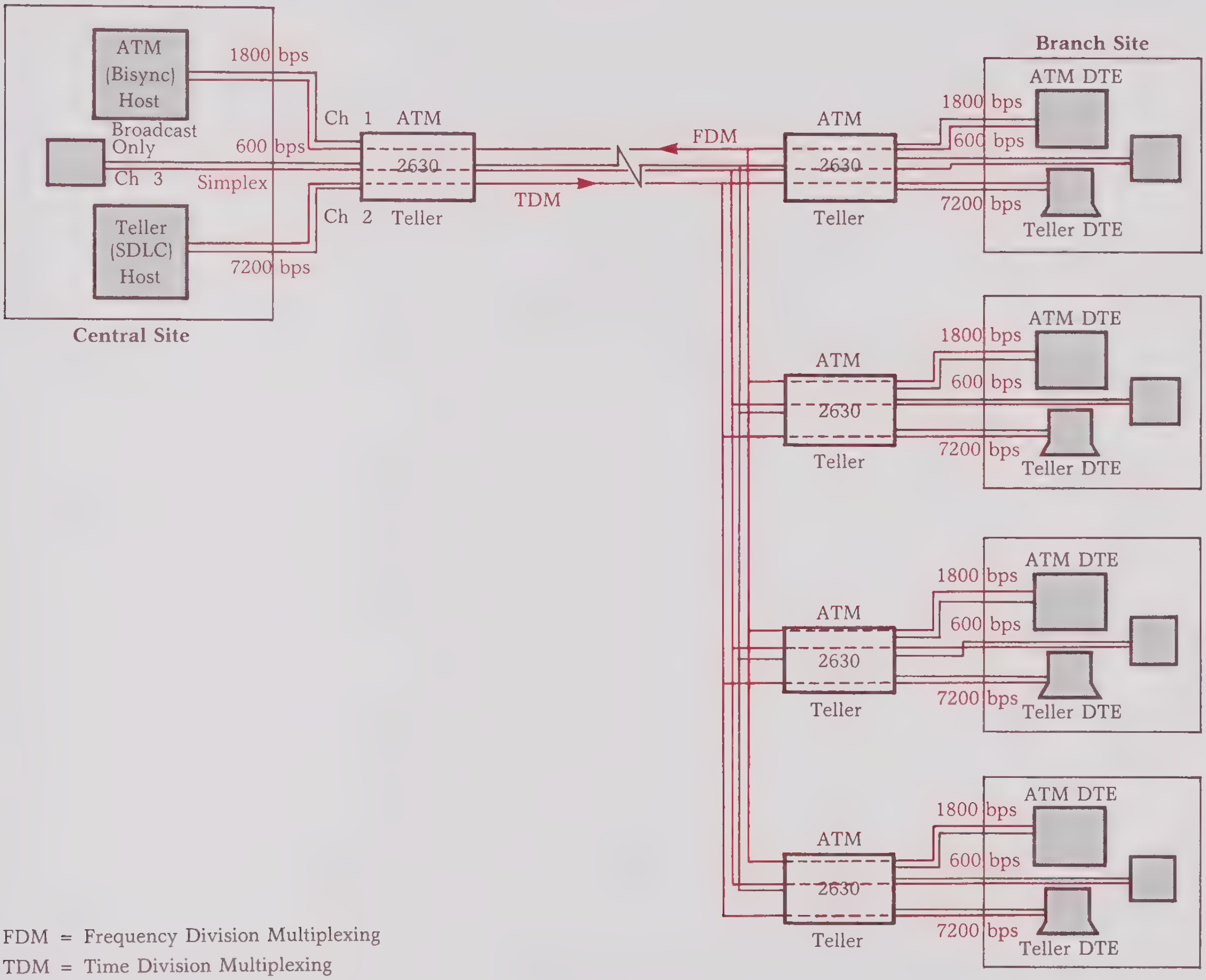
Laracy Trust, Inc. has experienced phenomenal growth in the last three years and acquired a number of other savings and loan institutions that must be integrated into its current network.

While the teller terminals in each of the bank branches are compatible (all function in an IBM SDLC environment), there are problems. The institution also maintains an ATM network which runs to the same branches at a slower speed from a different host computer. This host computer is linked to the Laracy Trust, Inc. site in a bisync (i.e., non-SDLC) application. Thus, the banking group requires separate parallel multipoint lines to accommodate the two applications.

For a while now, Laracy has been struggling to find a way to cut down on the number of multipoint lines it has paralleling each other through its branches back to the Network Center. Compounding the issue, the bank president wants to broaden the offerings of the bank by making stock reports, interest rate changes, and investment advice available at the branch level.

The Codex 2630 Dual Multipoint Modem provides the solution. With the 2630 Modem, not only can Laracy integrate the ATM and teller networks via one multipoint line, but that same line also provides a ''broadcast only'' channel for the daily announcement of new bank offerings, current rates, or valuable investment data. This means that Laracy Trust, Inc. has the opportunity to increase operating efficiency with a potential decrease of up to 40 percent in time operating costs. The conversion to a single multipoint line simplifies procedures, alleviates complex maintenance of multipoint lines at the central site, and streamlines available services for the customer.

For Laracy Trust, Inc., the Codex 2630 is simply the best solution there is for streamlining and customizing its multipoint applications.


ATM
(Bisync)
Host
1800 bps
Broadcast
Only
600 bps
Ch 3
Simplex
Teller
(SDLC)
Host
7200 bps
Central Site
Ch 1
ATM
2630
Ch 2
Teller
TDM
FDM
ATM
2630
Teller
Branch Site
ATM DTE
1800 bps
600 bps
7200 bps
Teller DTE

FDM = Frequency Division Multiplexing
TDM = Time Division Multiplexing

Figure 2-1. 2630 Modem Advantage

2630 Modem
User's Manual
Part No. 08593
November 1986

USER QUESTIONNAIRE

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Title ____________________ Years in position ________

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Are the operating instructions clear and complete?		1	2	3	4	5	
How helpful are the troubleshooting procedures?		1	2	3	4	5	
Does the manual accurately describe how the equipment works?		1	2	3	4	5	
How clearly are terms or concepts defined or explained?		1	2	3	4	5	
How well is the manual organized?		1	2	3	4	5	
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How useful is color in the illustrations?		1	2	3	4	5	
How helpful is the index?		1	2	3	4	5	
Are the design applications examples helpful?		1	2	3	4	5	
Is the reference card useful?		1	2	3	4	5	
How would you compare this manual to other similar manuals you have used?		1	2	3	4	5	

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WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

Writer: Regina Sackmary
Editor: Lisa A. Maregni

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Contents

Chapter 1. Features and Operation

General 1-1
2650 Product Features 1-2
Operating Modes 1-2
  High-Speed Multipoint Modes 1-4
  Multipoint Modes 1-5

Chapter 2. Application Examples

General 2-1
Example One: 2650 Modem and Network Management Systems 2-1
Example Two: 2650 Modem High-Speed Advantage 2-2

Chapter 1
Features and Operation

Contents

General 1-1
2650 Product Features 1-2
Operating Modes 1-2
  High-Speed Multipoint Modes 1-4
  Multipoint Modes 1-5

GENERAL

The 2650 High-Speed Multipoint Data Modem is a 2600 Series modem. It provides outstanding performance and reliability for data communications applications that require maximum effective throughput in multipoint networks. Accelerated response time, outbound rates up to 16.8 kbps, and automatic retrain on the outbound line are unique to the 2650. This means an increased number of transactions per hour and better performance over your multipoint lines. The outbound performance of the 2650 at 14.4 kbps approaches that of current 9600 bps modems.

You use the 2650 modem in the same way you configure any multipoint setup. However, with enhanced high-speed operating modes, the 2650 gives you the choice of adding terminals to expand your network without requiring new lines, or improving response time by upgrading data transmission rates within your current multipoint setup. The effectiveness of these choices is shown in the application examples in Chapter 2.

2650 PRODUCT FEATURES

All the standard features of the 2600 Series modems, including Network Management Systems, are available on the 2650 high-speed multipoint modem. For general information on these features, refer to the *2600 Series User's Manual.* This guide describes only those capabilities specific to the 2650 modem, as follows:

- Control Panel (with Remote Capability)
- Network Management Systems. Integration is provided in DNCS 200/300 Release 5.03 and 4850/4860 Release 1.03.
- Network Management Systems Control Channel: FSK 75/110 bps
- Trellis Coded Modulation (TCM)
- Circuit Quality Monitoring System (CQMS)
- Multipoint Signal Quality Binning (MSQB)
- Mixed Inbound Rate (MIR)
- Eye Pattern Generator (EPG)
- Power-Up Self Test
- Data Handling: Sync, Async 6 to 9 bits, Block Isoc
- Multiport Option: 4 DTE ports; 2- to 4-port MSU
  6 DTE ports; 2- to 6-port MSU
- Audio Features: Domestic 4-wire leased; 3002
- Dual Dial Restoral (DDR)
- Communications Test Equipment (CTE)
- Power Fail Alarm

OPERATING MODES

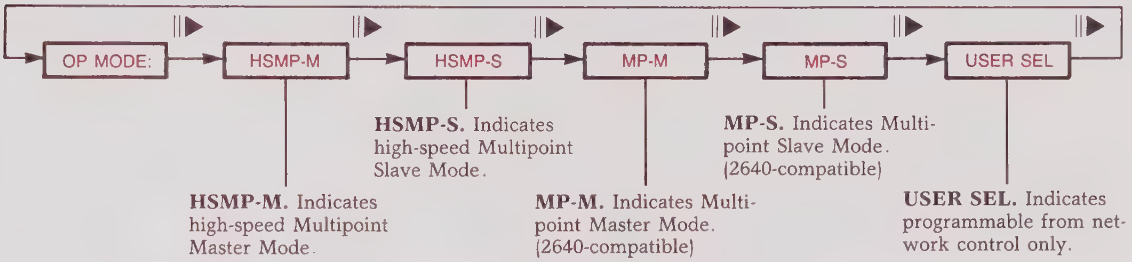
You can operate the 2650 modem independently or as part of the Codex Network Management System. Using the local 2650 Control Panel, you are able to monitor, configure, and control local and remote modems. With Network Management Systems, you can perform all the standard operating procedures to multiple networks, while maintaining logs of alarms and problem indicators.

The 2650 operates in multipoint mode over 3002 4-wire leased lines. Two different types of modes on the 2650 ensure optimum performance and compatibility. High-Speed Multipoint Mode (HSMP) offers you a range of operation in 2400 bps increments from 9600 to 16,800 bps outbound and from 4800 to 9600 bps inbound. This mode is compatible with other 2650 modems only. Multipoint Mode (MP), which utilizes Codex-Improved (CI) 9600 modulation, is fully compatible with the Codex 2640 modem in multipoint applications with both inbound and outbound speeds ranging from 4800 to 9600 bps, and a 17 ms training time in the master modem.

Operating mode compatibilities are shown below:

Operating Mode	*2650 Compatibility*	*2640 Compatibility*
HSMP-M	•	
HSMP-S	•	
MP-M	•	•
MP-S	•	•

Operating modes for the 2650 are as follows. These modes appear on the Control Panel display of the Configuration Tree, which is fully described in Chapter 4 of the *2600 Series User's Manual.*



HSMP-S. Indicates high-speed Multipoint Slave Mode.

MP-S. Indicates Multipoint Slave Mode. (2640-compatible)

HSMP-M. Indicates high-speed Multipoint Master Mode.

MP-M. Indicates Multipoint Master Mode. (2640-compatible)

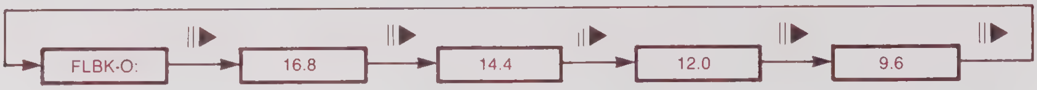
USER SEL. Indicates programmable from network control only.

For multiport units, the top line of the Configuration Tree in Chapter 4 of the *2600 Series User's Manual* lists MUX 1* and MUX 2* categories. Also, the subcategory MUX MOD: appears in the MODEM* category, under OP MODE:. In 2600 Series modems, these categories usually allow you to select mux modes and the user-special configurations for the mux. However, the 2650 does not have mux modes. If you attempt to select MUX 1* or MUX 2* on the Control Panel, the parameters will not function for the modem. Do not use those categories. Instead, you should establish an MSU for your configuration requirements.

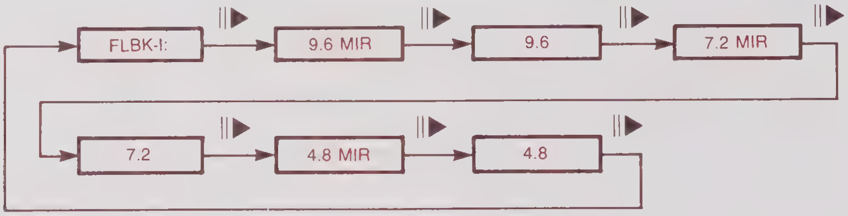
The following sections describe HSMP and MP modes in detail. Their characteristics are summarized in Table 1-1 at the end of this chapter.

High-Speed Multipoint Modes

The outbound rates in 8-state Trellis Coded Modulation (TCM) over constant carrier for High-Speed Multipoint Master (HSMP-M) run as follows:



The inbound rates over switched carrier for High-Speed Multipoint Slave (HSMP-S) run as follows:



HSMP-M and HSMP-S operating modes are compatible with other 2650 modems. Equalization recovery is accomplished through the Cry For Help (CFH) function, permitting automatic retrain of slaves on the outbound line. The CFH technique allows a slave that has lost equalization to request a retrain from the master. The slave sends a short signal on the inbound line which can be detected by the master receiver as something different from a normal inbound training sequence. The master receiver then signals the master transmitter to send a retrain to all slaves.

The CFH signal disrupts data transmission until the retrain occurs. However, after 10 seconds, the frequency of CFH drops to once in every forty seconds. This minimizes disruption and allows polling to continue; thus, a modem that cannot acquire synchronization on the outbound line will not bring down the whole network. Using the CFH technique ensures that there will be no loss of synchronization in the multipoint system even at high speeds of 14.4 or 16.8 kbps.

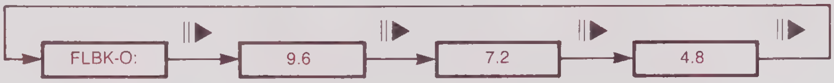
Loopback timing should not be used in the HSMP modes of the 2650 modem, since it is a complex timing arrangement that does not operate with asymmetrical or mixed inbound rates. For loopback timing, modems cannot have different bit rates or modulation modes on the inbound and outbound links. Digital loopback (when it is selected) will force symmetrical inbound and outbound rates as required.

In order to properly perform a BER (Bit Error Rate) test, the 2650 modems must either be running at symmetrical rates, or the outbound speed must exceed the inbound speed. If you choose to initiate a BER test from a 2650 slave modem, first adjust your rate accordingly.

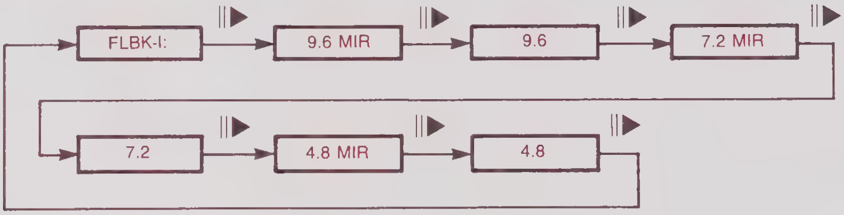
■ **Note:** The 2650 should not be used in high-speed multipoint mode as a tail circuit off a multiplexed point-to-point modem. The multiplexed modem cannot support an asymmetrical rate on any channel.

Multipoint Modes

The outbound rates for Multipoint Master (MP-M) over constant carrier are:



The inbound rates for Multipoint Slave (MP-S) over controlled carrier are:



The 2650 and 2640 modems are compatible in the MP-M and MP-S operating modes. Equalization recovery is accomplished through the nondisruptive Train On Data (TOD) method, through which the slave modem recovers synchronization by reading the data sequence sent by the master modem. The slave modem then goes back on line, without disrupting data transmission on any other modem and without the need for Network Management Systems. (Inbound transmissions are always preceded by a training sequence and do not require equalization recovery.)

Table 1-1.
2650 Operating Modes

Operating Mode	*Data Rate (kbps)*	*Transmit Carrier*	*Telephone Line Requirements*	*Training Time (ms)*	*Equalization Recovery Method*
HSMP-M	16.8 14.4 12.0 9.6	Constant	3002	492 392 292 192	None
HSMP-S	9.6 9.6 MIR 7.2 7.2 MIR 4.8 4.8 MIR	Controlled	3002	17	Cry For Help
MP-M	9.6 7.2 4.8	Constant	3002	253	None
MP-S	9.6 9.6 MIR 7.2 7.2 MIR 4.8 4.8 MIR	Controlled	3002	17	Train On Data

■ **Note:** Recommended Operating Mode: HSMP-M or HSMP-S (unless 2640 compatibility required)

Chapter 2
Application Examples

Contents

General 2-1
Example One: 2650 Modem and Network Management Systems 2-1
Example Two: 2650 Modem High-Speed Advantage 2-2

GENERAL

This chapter introduces you to two applications for which the 2650 modem is well suited. Both sample networks described use the 2650 High-Speed Multipoint Modem to solve a pressing data communications problem.

EXAMPLE ONE: 2650 MODEM AND NETWORK MANAGEMENT SYSTEMS

Manhal Industries, which owns and operates seven manufacturing plants across the southeastern United States, acquired the Sights Insurance firm to accommodate the insurance needs of Manhal's employees. Sights Insurance had experienced severe problems in servicing its clients: there had been a steady increase in sales contracts, but Sights was constrained by an antiquated system of processing claims over slow multipoint lines with a limited number of drops.

Once Sights Insurance had been resituated near Manhal headquarters in Atlanta, Manhal's MIS division developed the configuration for a communications network between Sights and all seven plants in Manhal operations.

The MIS group concluded that adding lines to the newly-acquired insurance company would be too expensive at that stage. Also, they did not want to experience further degradation of response time due

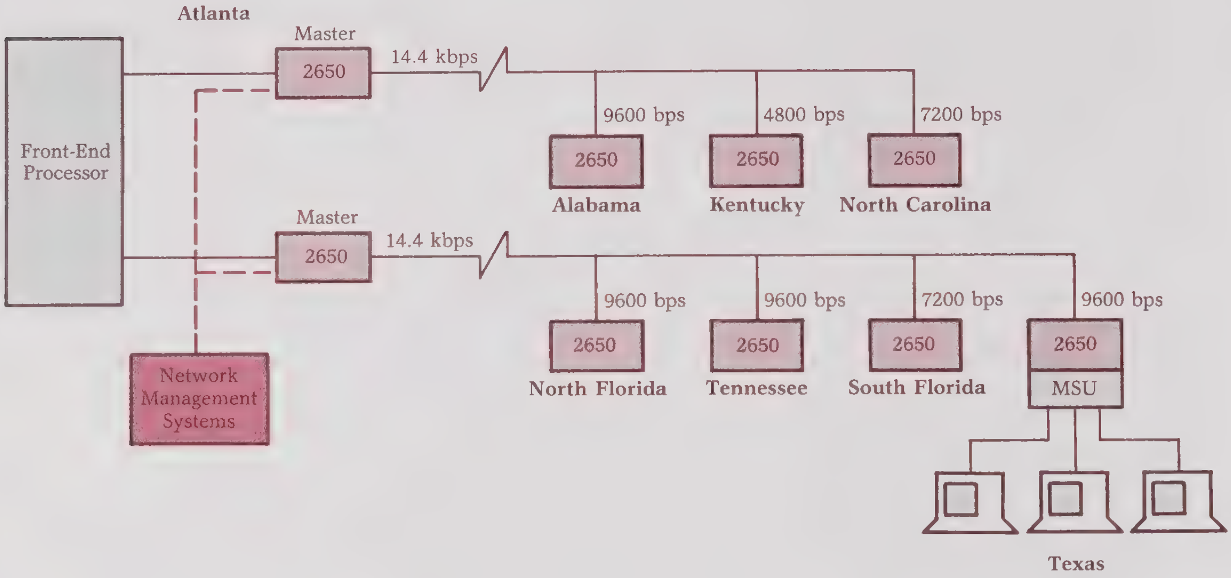

Atlanta
Front-End Processor
Master
2650
14.4 kbps
9600 bps
4800 bps
7200 bps
2650
2650
2650
Alabama
Kentucky
North Carolina
Master
2650
14.4 kbps
9600 bps
9600 bps
7200 bps
9600 bps
2650
2650
2650
2650
MSU
North Florida
Tennessee
South Florida
Network Management Systems
Texas

Figure 2-1. 2650 Modem and Network Management System at Sights Insurance

to increased transactions on the existing multipoint lines.

However, Manhal Industries already had its own network system that utilized Codex high-speed 2650 modems over multipoint lines. By replacing the modems Sights Insurance was using with 2650 modems, two solutions were immediately available to help the insurance company:

- Sights could retain the same number of terminals but have the high-speed transmission of the 2650, and thereby receive improved response time rates. This would give Sights a corresponding increase in the number of transactions per hour.
- Sights could add more terminals to the *same* multipoint line it already had — saving the exorbitant cost of adding more lines — and maintain reasonable response times.

Sights Insurance, with the advice of Manhal Industries, chose to increase the high speed over current multipoint lines — resulting in a significant increase in turnover of claim applications. This solution is illustrated in Figure 2-1. Within a month, the Sights Insurance Company was not only keeping pace with its expanding clientele, it was monitoring and maintaining an expanding networking system.

EXAMPLE TWO: 2650 MODEM HIGH-SPEED ADVANTAGE

As an up-and-coming telemarketing firm, Sorel-Tel believed that its purchase of an advanced software package was the best way to simplify its methods of processing telephone communications data. The firm had originally installed a traditional 9600 bps multipoint system that transmitted all received data to the central computer for processing. However, the new software would allow operators at various terminals to preview the data much more efficiently; it provided menu-driven screens that the operators could use for selecting only the relevant material for transmission.

In the past, Sorel-Tel's remote terminal operators had to key in everything a customer said in a telemarketing conference. With the new software, they were able to tab easily from field to field of data on a screen and fill in only those areas to which the customer responded. This change doubled the number of transactions the Sorel-Tel operator could perform. In addition, operators could locate background or historical information from a central database in order to respond adequately to potential consumer queries about an organization or product being researched.

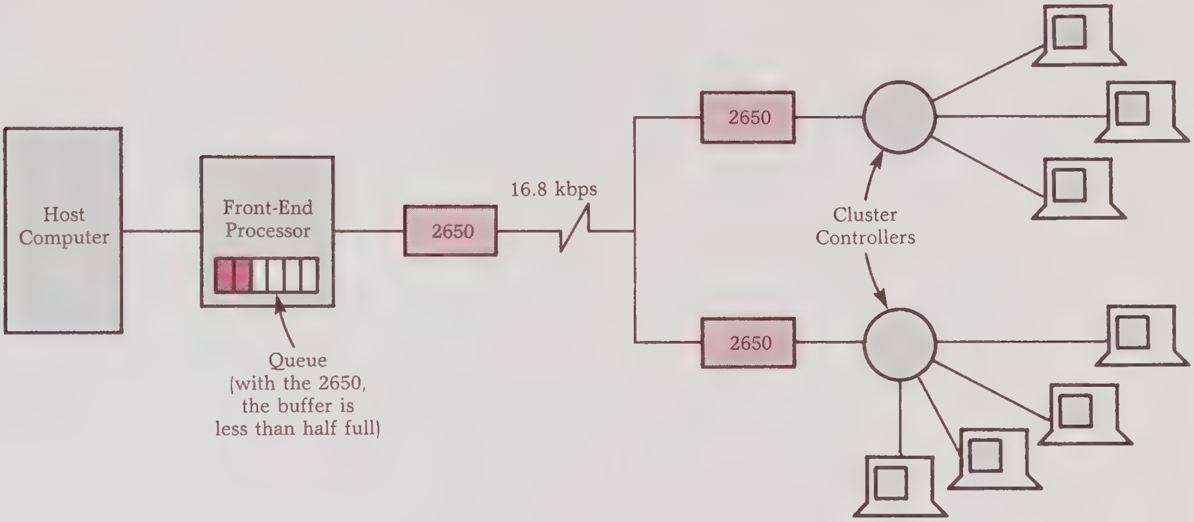


Figure 2-2. 2650 Modem High-Speed Advantage at Sorel-Tel

The problem that emerged, not surprisingly, was that the existing multipoint lines worked very well on the inbound route, but the system in the outbound direction was bottlenecked! The queue buffer of outbound messages in the front end processor (FEP) was over capacity. The length of this queue and the time for a new message to get to the front of the queue are affected very strongly by the speed of the outbound link, so response time for Sorel-Tel communications was seriously impaired. Because the new software required extensive outbound data to transmit advanced graphics, displays, and data base information to remote DTEs, the standard 9600 bps outbound rate on which Sorel-Tel functioned became a liability. The data was available — it just couldn't be pulled across the communication lines fast enough. The added traffic on the outbound route slowed everything to a crawl, and the cost of operating the system increased, along with user complaints.

Sorel-Tel investigated means of upgrading the multipoint system to accommodate the new software. The company found that a high-speed multipoint system would alleviate the core problem of excessive queueing in the FEP. The Codex 2650 High-Speed Multipoint Modem — operating at speeds of 14.4 and 16.8 — made the difference. The firm replaced its old system with 2650 modems. Rapidly, the response time out to remote terminals was significantly reduced. This solution is illustrated in Figure 2-2. Sorel-Tel was then able to conduct its surveys and respond to customers without critical delays or downtime interruptions.

2650 Modem
User's Guide
Part No. 08507
March 1986

USER/READER COMMENTS

In order to improve the quality and utility of its manuals, Codex Corporation needs the active cooperation and participation of its user readership. Your comments as a user/reader will be greatly appreciated and reviewed for incorporation in the next revision of this manual.

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Did you find errors in this manual? If so, specify by page.

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Chapter 5
Installation and Troubleshooting

Contents

General 5-1
Unpacking/Repacking 5-1
Site Selection and Preparation 5-3
Installation Procedure 5-3
  Rack-Mount 5-3
  Electrical 5-6
Installation and Troubleshooting
  Flowcharts 5-13
  Modem Installation Flowcharts 5-13
  Troubleshooting Flowcharts 5-19
  Point-to-Point Trouble Indicators 5-19
  Multipoint Slave Trouble Indicators 5-19
  Multipoint Master Trouble Indicators 5-19
  Voltage Check 5-27

GENERAL

This chapter tells you how to install the 2600 Series Modem. It also serves as a guideline when troubleshooting a previously operational modem link.

UNPACKING/REPACKING

A shock-absorbing packing material is wrapped around each assembled 2600 Series Modem. As insurance against damage during shipment, a card support has been installed, as shown in Figure 5-1. The card support does not interfere with the operation of the modem and can be left in place during operation or removed and retained with the shipping carton. If you repackage the unit for shipment, replace the card support. Retain the packing material and carton for storage or repackaging and shipment.

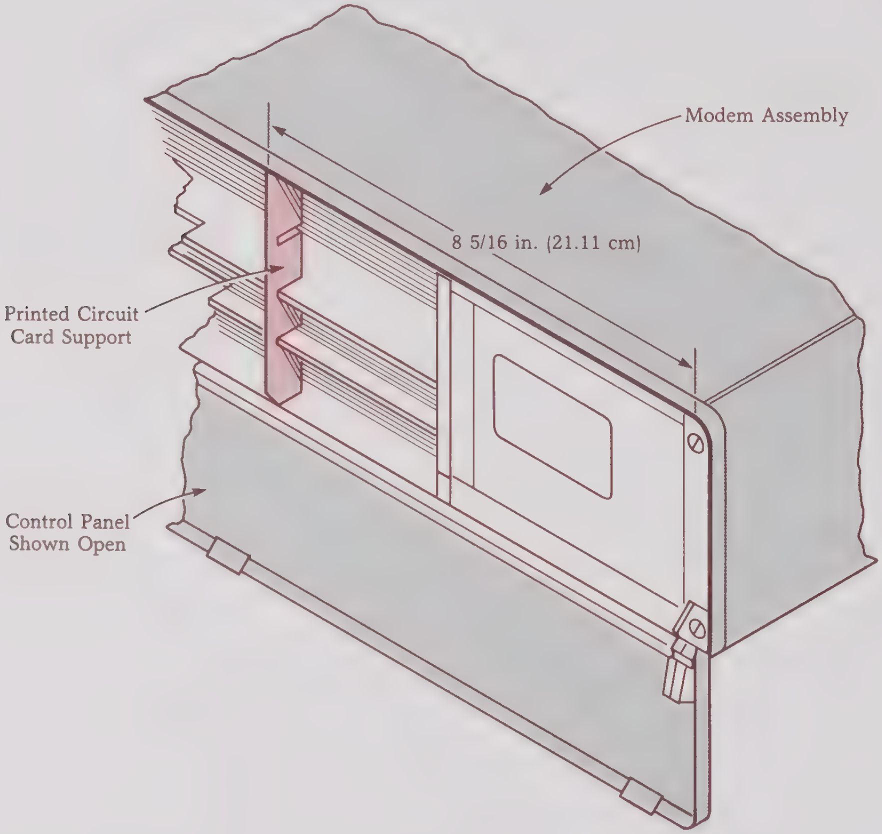


Figure 5-1. PC Card Supports

Customer audits by Codex indicate that rough handling by the shipper causes most early failures. After unpacking the unit, check carefully for damage that may have occurred in shipment. Before applying power, check the circuit boards for components that may have been jarred or shaken loose in transit. Having successfully completed this inspection, you may proceed with the installation procedure confident that the equipment will give excellent results when configured to your communications system.

If you note any damage, contact the shipping agent. If you have any additional questions regarding the damage or material shortage, notify the nearest Codex representative for advice and assistance, or contact:

Codex Corporation
Sales Operations
Maresfield Farm
7 Blue Hill River Road
Canton, Massachusetts 02021-1097

If you are a customer outside the United States, contact your nearest Motorola representative.

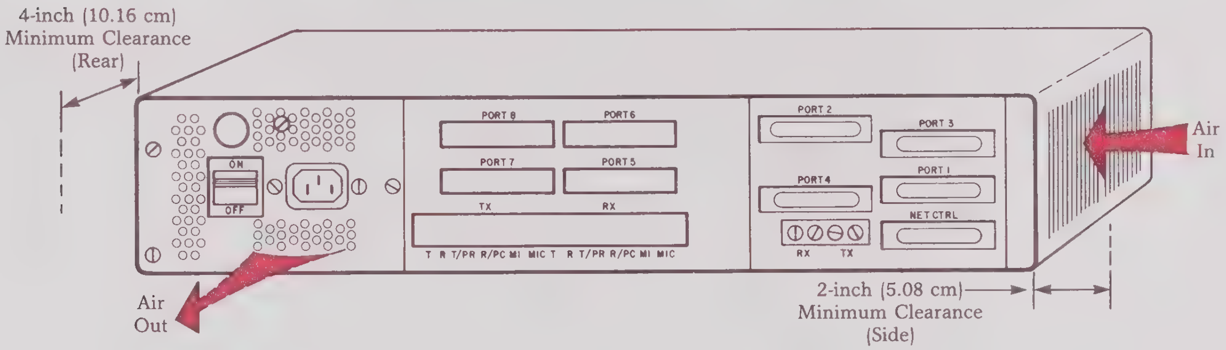

4-inch (10.16 cm)
Minimum Clearance
(Rear)
ON
OFF
PORT 8
PORT 6
PORT 7
PORT 5
TX
RX
T R T/PR R/PC MI MIC T R T/PR R/PC MI MIC
PORT 2
PORT 3
PORT 1
PORT 4
NET CTRL
RX TX
Air
In
Air
Out
2-inch (5.08 cm)
Minimum Clearance
(Side)

Figure 5-2. Modem Clearance Requirements

SITE SELECTION AND PREPARATION

The 2600 Series Modem must be situated within 7 feet (2.1m) of a grounded AC outlet that can furnish the required power. Refer to the specifications in Chapter 1 for power requirements.

The installation site must be clean, well lighted, and free from extremes of humidity, appreciable shock, and vibration. Refer to the specifications in Chapter 1 for operating temperature requirements. Allow at least 36 inches (91.4 cm) of frontal clearance for your access and at least 4 inches (10.2 cm) of clearance at the rear for cabling. The 2600 Series Modem is fan-cooled and requires minimum clearance for proper operation. Figure 5-2 identifies those clearances. ■ **Note:** Ensure at all times that air inlets are not blocked.

INSTALLATION PROCEDURE

You should be familiar with the complete installation procedure before attempting to install the 2600 Series Modem.

Rack-Mount

The modem can be installed in a standard 19-inch-wide (48.3 cm) rack, with front-to-rear rail spacings of 12.6 inches (32 cm), 14.25 inches (36.2 cm), 18 inches (45.7 cm), or 19.5 inches (49.5 cm), by using a Rack-Mount Kit (Product Code 31030). ■ **Note:** All specifications of the Dimensions and Weights section in Chapter 1 and the fan-cooling precautions of the Site Selection and Preparation section of this chapter apply to the rack-mount unit. In addition, for all rack-mounted units, be careful to provide suitable airflow through the rack to limit the maximum ambient temperature surrounding the modem to 122°F (50°C). Install supplemental cooling such as the Codex Rack-Mount Fan Assembly (Product Code 23580) if more than ten units are placed in the same rack.

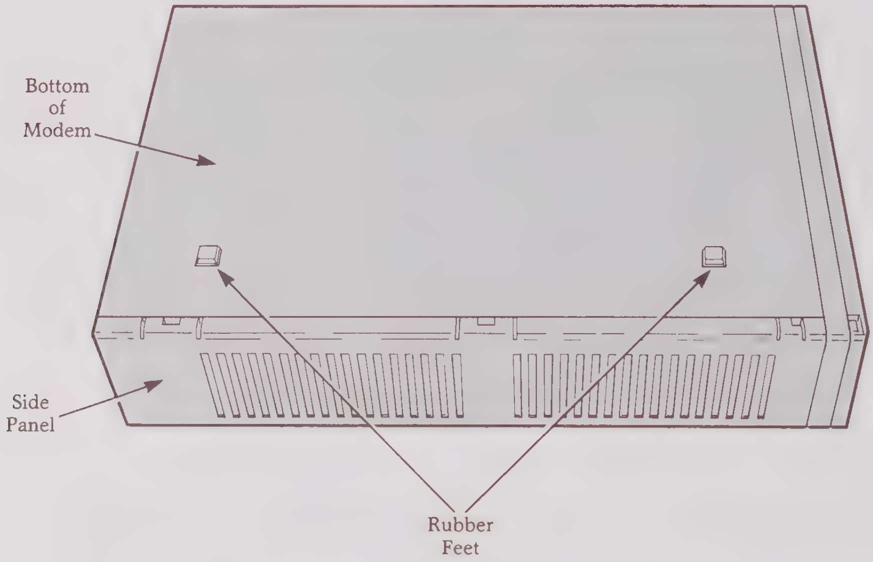
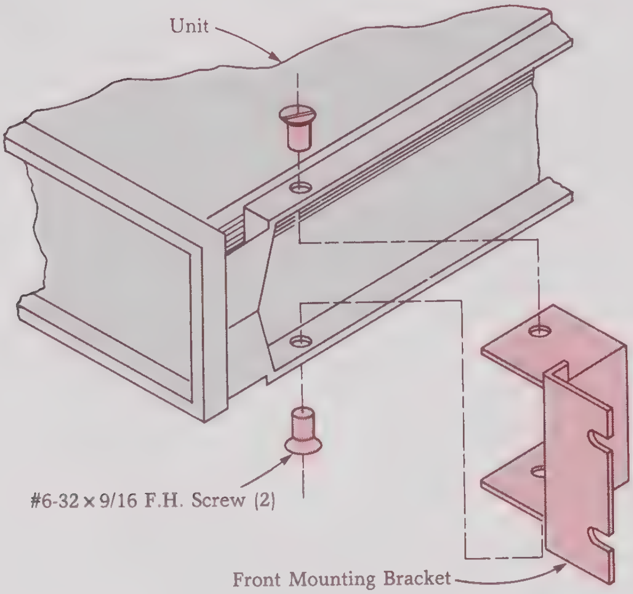


Figure 5-3. Removal of Side Panels

To mount your 2600 Series Modem, do the following:

1) Remove the rubber feet from the bottom of the modem.
2) Remove the side panels of the modem by inserting a screwdriver into each of the three slots along the bottom side edge of the modem (see Figure 5-3).
3) Using No. 6-32 × 9/16 flat-head screws, attach the front mounting bracket to the unit (see Figure 5-4).
4) Using No. 6-32 × 9/16 flat-head screws, attach the rear mounting bracket to the unit (see Figure 5-5).
5) Using No. 12-24 speed nuts, place all nuts onto the rack in appropriate locations. Then slide the unit into place and mount the front brackets, using No. 12-24 × 1/2 screws.
6) After the unit is in the rack, go to the back of the unit and mount the rear adjusting bracket to the rear mounting bracket, using No. 10-32 × 1/2 pan-head screws, No. 10 washers, and internal tooth washers (see Figure 5-6). (Depending on the rear rail position within the rack, the rear adjusting bracket may be oriented 180° from the position shown.)
7) Mount the rear adjusting bracket to the rack using No. 12-24 × 1/2 screws (see Figure 5-6).


Unit
#6-32 × 9/16 F.H. Screw (2)
Front Mounting Bracket

■**Note:** Mount typically on both sides of unit.

Figure 5-4. Front Bracket Mounting

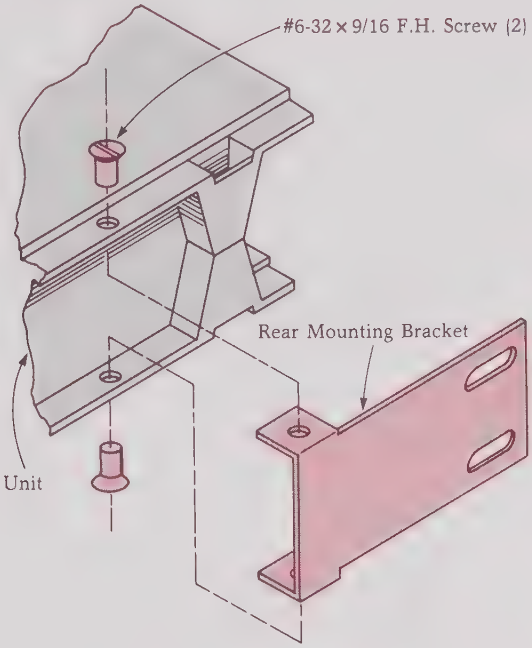

#6-32 × 9/16 F.H. Screw (2)
Rear Mounting Bracket
Unit

Figure 5-5. Rear Bracket Mounting

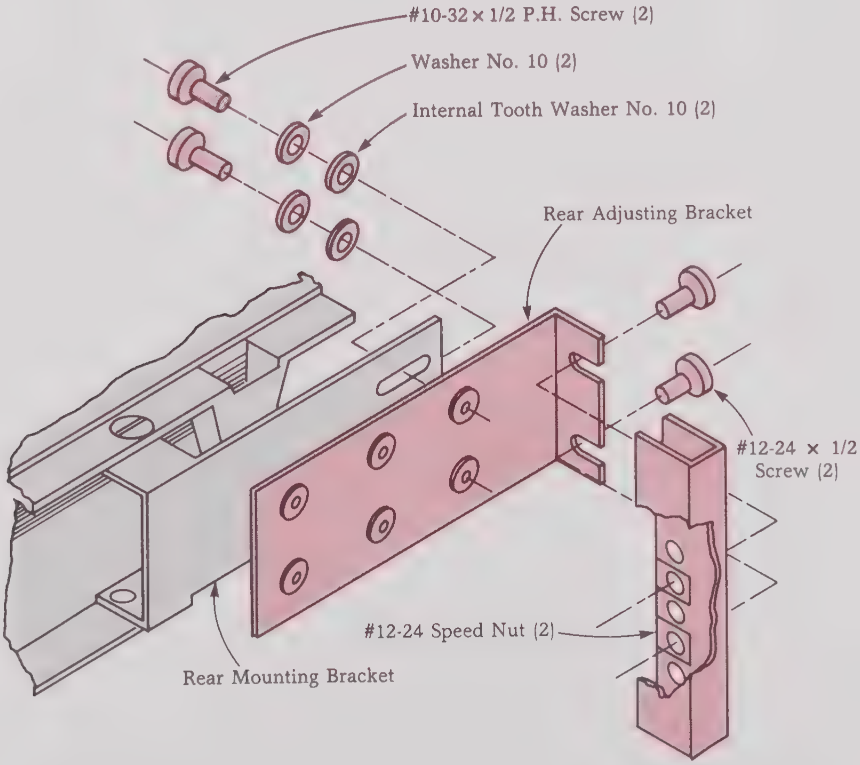

#10-32 × 1/2 P.H. Screw (2)
Washer No. 10 (2)
Internal Tooth Washer No. 10 (2)
Rear Adjusting Bracket
#12-24 × 1/2 Screw (2)
#12-24 Speed Nut (2)
Rear Mounting Bracket

Figure 5-6. Rear Bracket Subassembly

Electrical

The following sections describe the AC power cord and the rear panel input/output (I/O) card.

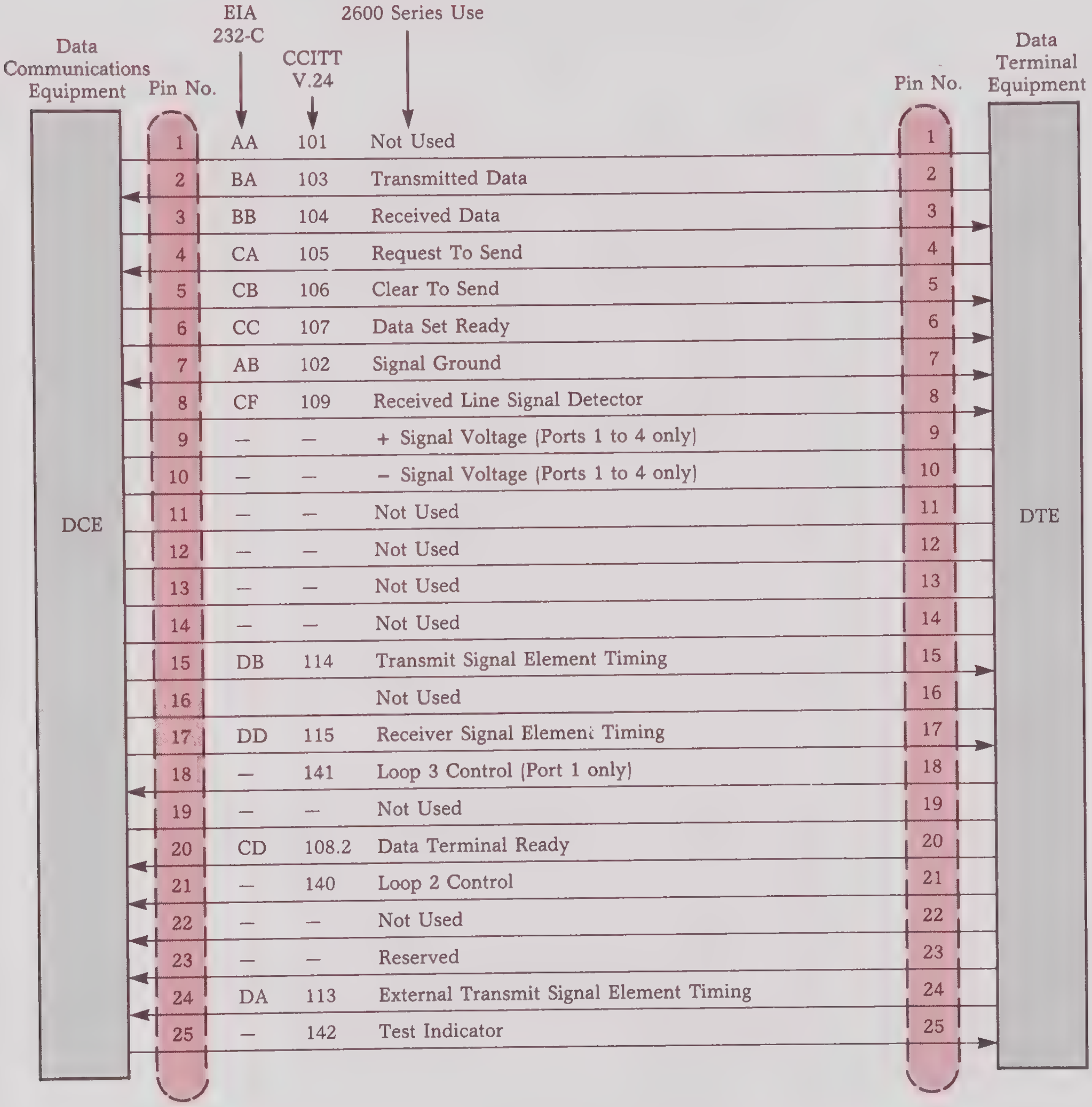
AC Power Cord. A 7-foot (2.1m) line cord terminated with a 3-wire plug is used to supply AC power.

Rear Panel I/O Card. The 2600 Series Modem includes a standard I/O rear panel, which contains all necessary connection pins for the multiplexer and Dual Dial Restoral (DDR) options. Connections for Ports 1 through 4 are supplied as standard. However, only Port 1 is available for use unless you have ordered a a Multiplexer option. Ports 6 through 8 and DDR locations are labeled but will not have connectors unless you have ordered the 6-channel Multiplexer or DDR option.

Port 1, the standard EIA 232-C (CCITT V.24) interface, is a 25-pin connector supplying input/output data, control status, and timing interface signals between the modem and the data terminal equipment. Ports 2 through 4 are identical to Port 1 and are used for Ports 2 through 4 of the multiplexer.

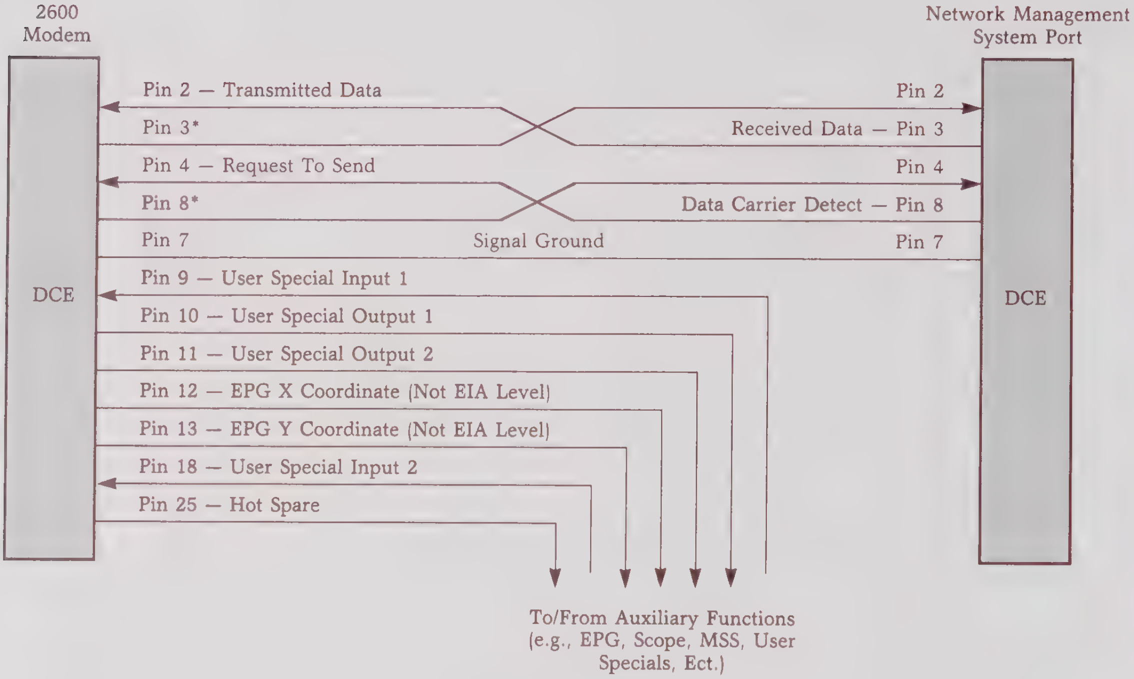
Note that when you have set the modem in the multipoint mode, only Port 1 is used.

Figure 5-7 illustrates the I/O interface cabling; Figure 5-8 illustrates the modem to Network Management Systems interface cabling. The signals are shown as originating either in the data communications equipment (DCE) or the data terminal equipment (DTE). The interface is compatible with EIA 232-C and CCITT standards. These standards provide guidelines for the interconnection of equipment via a 25-pin connector and specify that interface voltages may range from +3 to +15 for positive, and −3 to −15 for negative (see Figure 5-9). Operation in the range of +3 to −3 is not allowed due to noise. Table 5-1 lists and describes each terminal interface signal for EIA 232-C and CCITT V.24.



Pin No.	EIA 232-C	CCITT V.24	2600 Series Use	Pin No.
1	AA	101	Not Used	1
2	BA	103	Transmitted Data	2
3	BB	104	Received Data	3
4	CA	105	Request To Send	4
5	CB	106	Clear To Send	5
6	CC	107	Data Set Ready	6
7	AB	102	Signal Ground	7
8	CF	109	Received Line Signal Detector	8
9	—	—	+ Signal Voltage (Ports 1 to 4 only)	9
10	—	—	− Signal Voltage (Ports 1 to 4 only)	10
11	—	—	Not Used	11
12	—	—	Not Used	12
13	—	—	Not Used	13
14	—	—	Not Used	14
15	DB	114	Transmit Signal Element Timing	15
16			Not Used	16
17	DD	115	Receiver Signal Element Timing	17
18	—	141	Loop 3 Control (Port 1 only)	18
19	—	—	Not Used	19
20	CD	108.2	Data Terminal Ready	20
21	—	140	Loop 2 Control	21
22	—	—	Not Used	22
23	—	—	Reserved	23
24	DA	113	External Transmit Signal Element Timing	24
25	—	142	Test Indicator	25

Figure 5-7. Modem to Data Terminal Interface Cable


2600 Modem
Network Management System Port
DCE
DCE
Pin 2 — Transmitted Data
Pin 2
Pin 3*
Received Data — Pin 3
Pin 4 — Request To Send
Pin 4
Pin 8*
Data Carrier Detect — Pin 8
Pin 7
Signal Ground
Pin 7
Pin 9 — User Special Input 1
Pin 10 — User Special Output 1
Pin 11 — User Special Output 2
Pin 12 — EPG X Coordinate (Not EIA Level)
Pin 13 — EPG Y Coordinate (Not EIA Level)
Pin 18 — User Special Input 2
Pin 25 — Hot Spare
To/From Auxiliary Functions (e.g., EPG, Scope, MSS, User Specials, Ect.)

*These signals are RS-423 type tri-state drives for the wired MSU. They have a voltage swing of ±4.6 volts.

■**Note:** When a 2600 Series modem powers on, a transient glitch on the hot spare switchover causes the Codex Modem Substitution Switch (MSS) to perform a switchover. If it is important to the user that a particular modem is online, manually set the MSS to the desired modem when power is applied to the 2600.

Figure 5-8. Modem to Network Management System Interface Cable

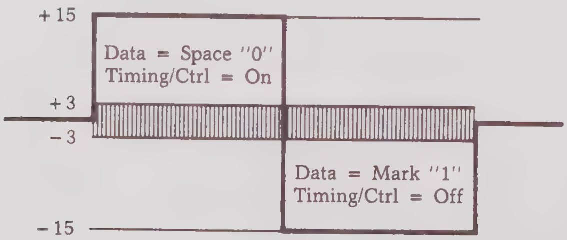

+15
+3
−3
−15
Data = Space "0"
Timing/Ctrl = On
Data = Mark "1"
Timing/Ctrl = Off

Figure 5-9. EIA/CCITT Voltage Levels

Table 5-1.
Terminal Interface Signals

Pin	*EIA 232-C*	*CCITT V.24*	*Signal Name*	*Description*
1	—	—	—	Not used.
2	BA	103	Transmitted Data (TD)	Serial digital data from a data terminal or other digital source. Data transitions must occur on positive-going transitions of the transmit clock. Data is sampled by the modem on the negative-going transitions of the transmit clock.
3	BB	104	Received Data (RD)	Serial digital data at the output of the modem receiver. The data is accompanied by an internal data rate clock (DD). Data transitions occur on the positive-going transitions of the receive clock.
4	CA	105	Request To Send (RTS)	A positive level to the modem when data transmission is desired. A negative level to the modem when transmission is not required. Can be configured via the Control Panel to be always On (positive).
5	CB	106	Clear To Send (CTS)	A positive level from the modem, after receipt of Request To Send (CA), and when the modem is ready to transmit. Clear To Send is low during training, test, or when Request To Send is low. The RTS/CTS delay (CA/CB delay) is user-configurable via the Control Panel and is a minimum of training delay time in control carrier applications.
6	CC	107	Data Set Ready (DSR)	A positive level from the modem when power is on and the modem is not in the following test conditions: • Digital Loopback Test (e.g., V.54 Loop 2). • Test modes which replace user data with modem-generated data (e.g., BER Test). DSR may be strapped via the Control Panel to be always On (positive).
7	AB	102	Signal Ground	Common signal and DC power ground (common return).
8	CF	109	Data Carrier Detect (DCD)	A positive level from the modem when a received input (analog) signal is detected. DCD may be strapped via the Control Panel to be always On (positive).
9	—	—	—	+ Signal Voltage (Ports 1 to 4).
10	—	—	—	– Signal Voltage (Ports 1 to 4)
11	—	—	—	Not used.
12	—	—	—	Not used.
13	—	—	—	Not used.
14	—	—	—	Not used.

(continued on next page)

Table 5-1 (continued).
Terminal Interface Signals

Pin	*EIA 232-C*	*CCITT V.24*	*2600 Series Signal Name*	*Description*
15	DB	114	Transmitter Signal Element (DCE)	A transmitter data clock output from the modem for use by an external data source. Data transitions should correspond to positive transitions of the clock.
16	—	—	—	Not used.
17	DD	115	Receiver Signal Element (DCE)	A receive data rate clock output for use by the external data sink. Data transitions of received data correspond to positive clock transitions.
18	—	141	Loop 3 Control	A modem input from the DTE that commands a local analog loopback (modem check) and that complies with V.54. Can be enabled or disabled via the Control Panel (Port 1 only).
19	—	—	—	Not used.
20	CD	108.2	Data Terminal Ready (DTR)	A positive level to the modem from the DTE, indicating that the DTE is operational and the associated control signals (e.g., RTS) are valid.
21	—	140	Loop 2 Control	A modem input from the DTE that commands initiation of a remote digital loopback and that complies with V.54. Can be enabled or disabled via the Control Panel.
22	—	—	—	Not used.
23	CH	—	Data Signal Rate Selector (DTE)	CH is an input to the modem for fallback rate control (Port 1 only.) Can be enabled or disabled via the Control Panel.
24	DA	113	External Transmit Signal Element (DTE)	An external clock (usually from another DCE) for transmit timing/tracking.
25	—	142	Test Indicator	A positive level from the modem indicating that the modem has been commanded to enter a test mode or is initiating a command in which it will be involved in a test.

Equipment used in data communications networks is divided into two major categories: (1) data terminal equipment (DTE), and (2) data communications equipment (DCE). Some typical DTE devices are terminals, computer ports, and so on. Modems and multiplexer ports are typical DCE devices. DTE devices are normally connected to DCE devices, as shown in Figure 5-10.

In the event that a multiplexer port located at the remote site is connected to a low-speed modem, refer to Figure 5-11. In this case, when interconnecting the two DCE devices (low-speed modem and multiplexer port), you must use a special cable that is internally cross-wired, called a crossover cable. See Figure 5-12 for an illustration of the crossover cable. This application of equipment connected to the multiplexer port is referred to as a "tail circuit."

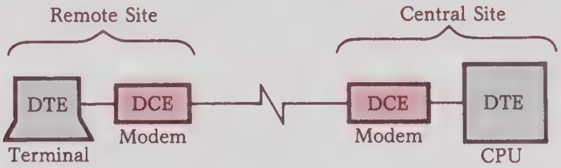

Remote Site
Central Site
DTE
DCE
DCE
DTE
Terminal
Modem
Modem
CPU

Figure 5-10. DTE/DCE Relationship

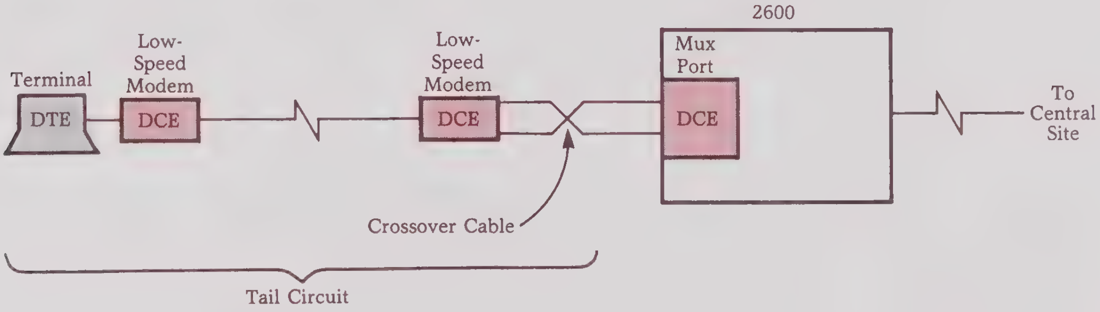

2600
Terminal
Low-Speed Modem
Low-Speed Modem
Mux Port
DTE
DCE
DCE
DCE
To Central Site
Crossover Cable
Tail Circuit

Figure 5-11. Example of Crossover Cable

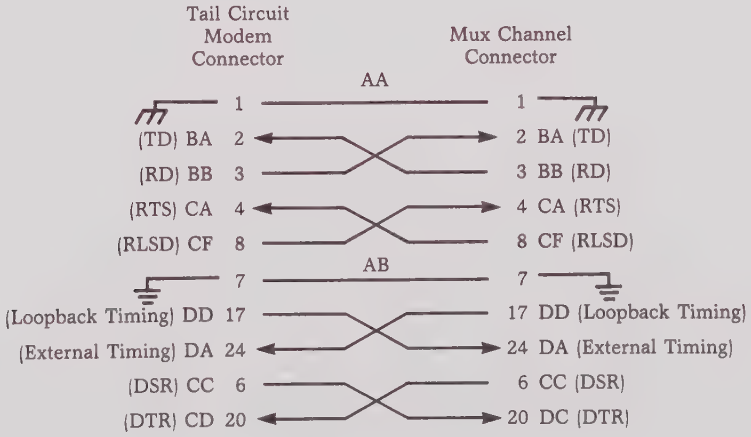

Tail Circuit Modem Connector
Mux Channel Connector
AA
1
1
(TD) BA 2
2 BA (TD)
(RD) BB 3
3 BB (RD)
(RTS) CA 4
4 CA (RTS)
(RLSD) CF 8
8 CF (RLSD)
AB
7
7
(Loopback Timing) DD 17
17 DD (Loopback Timing)
(External Timing) DA 24
24 DA (External Timing)
(DSR) CC 6
6 CC (DSR)
(DTR) CD 20
20 DC (DTR)

Figure 5-12. Requirements for Crossover Cable

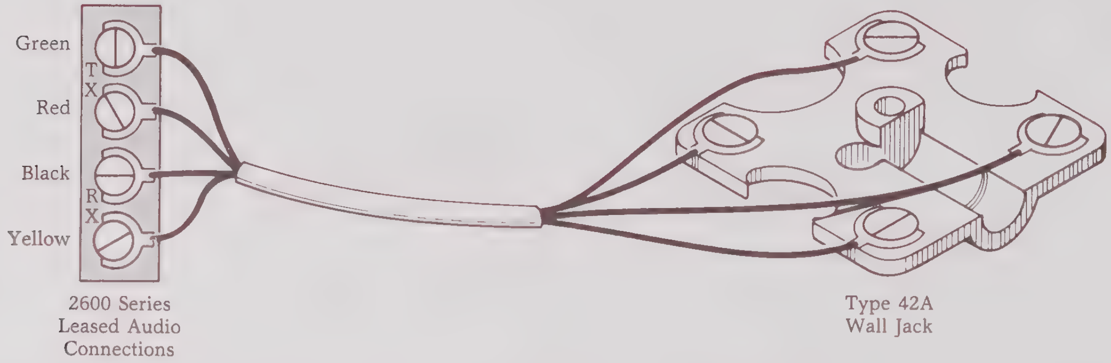

Green
TX
Red
Black
RX
Yellow
2600 Series Leased Audio Connections
Type 42A Wall Jack

Figure 5-13. Spade-to-Spade Cable Connections

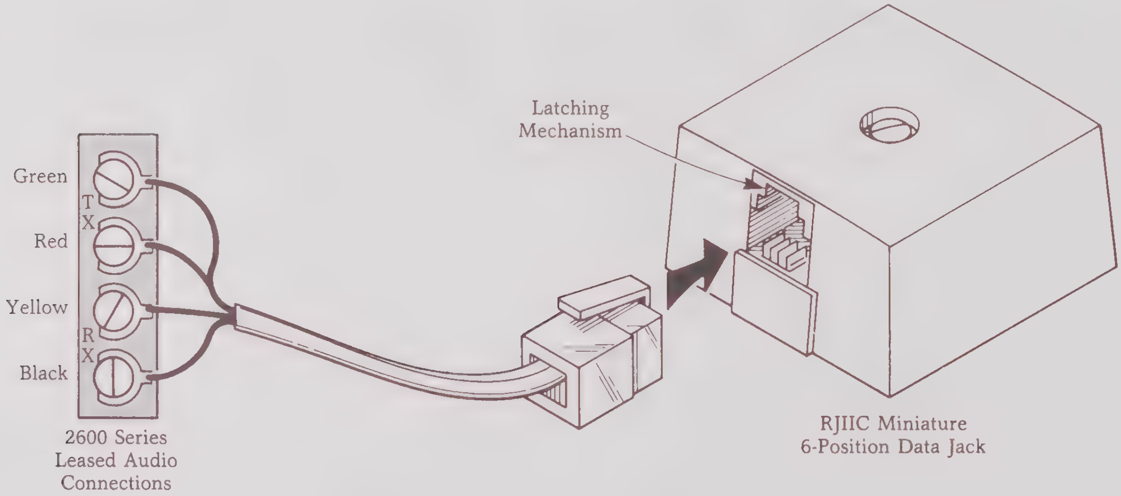

Green
TX
Red
Yellow
RX
Black
2600 Series Leased Audio Connections
Latching Mechanism
RJIIC Miniature 6-Position Data Jack

Figure 5-14. Spade-to-Modular Cable Connections

The crossover cable permits each DCE to communicate as though it were connected to a DTE. For example, the low-speed modem gets as transmit data what the muxport puts out as received data. The muxport sees as Data Terminal Ready (DTR) what the low-speed modem puts out as Data Set Ready (DSR). If a straight-through EIA/CCITT cable is used to connect a muxport to a low-speed modem, the system will not pass data.

A spade-to-spade modem to telephone line cable assembly is shown in Figure 5-13. Figure 5-14 illustrates a spade-to-modular modem to telephone line cable assembly.

INSTALLATION AND TROUBLESHOOTING FLOWCHARTS

The flowcharts in this section present suggested procedures for installing and troubleshooting the modem effectively. Once you have a practical knowledge of the 2600 Series Modem test features, you are encouraged to use these charts to find the best troubleshooting method.

■ **CAUTION:** *Before removing or inserting any cards or Control Panel connector, be certain that the modem is powered off.*

In the course of following the installation and troubleshooting flowcharts, you will be directed to other flowcharts for problem remedies. Once the problem has been resolved, return to the flowchart where the problem was first encountered. ■ **Note:** You must reenter the modem configuration when you replace a defective DTE card.

Modem Installation Flowcharts

This section consists of four installation flowcharts. Before powering up for installation, you should reseat each PC card as instructed in the Repair/Replacement section in Chapter 6. ■ **Note:** The number of errors called out in certain flowcharts for repeating an end-to-end test are approximations only; these values may be affected by line conditions. The installation flowcharts are as follows:

- ***Nontechnical Remote Installation.*** This is an installation performed at the remote site by nontechnical personnel. See Figure 5-15.
- ***Modem Confidence Check.*** This takes you from beginning to end of a power-up self-test sequence. Upon the completion of this flowchart, you will gain a high degree of confidence that the modem is functionally sound. This is functionally the same as the Nontechnical Remote Installation except that technical personnel are on all sites and a self-test is performed. See Figure 5-16.
- ***Preoperational Check.*** This check takes you through a communications-link confidence check and a modem end-to-end configuration compatibility check. This is the same as the Central Site Preoperational Check except that technical personnel are on all sites and the self-test was performed during the Modem Confidence Check. See Figure 5-17(A).
- ***Preoperational Check for TCM.*** This test is similar to the Preoperational Check in Figure 5-17(A) except that, instead of determining whether to run a BER or Poll Test where indicated, you must decide whether to run a BER or BLER Test. You would select a preoperational test for TCM if the BER Test has a 5×10^{-5} error rate, or if the BLER Test has a 1×10^{-3} error rate. See Figure 5-17(B).
- ***Central Site Preoperational Check.*** This Central Site Preoperational Check is performed after the Nontechnical Remote Installation, at which time the central site assumes control of the remote site. See Figure 5-18.

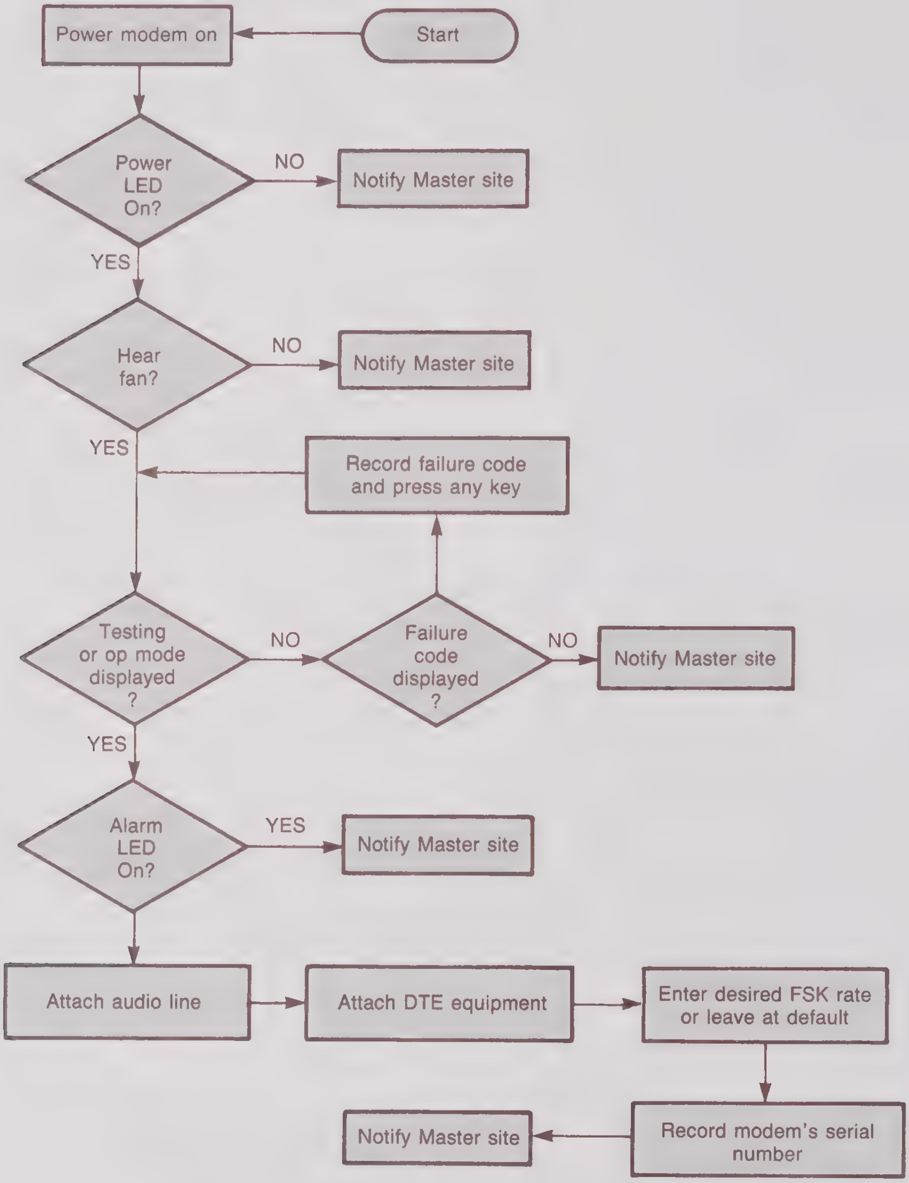

Start
Power modem on
Power LED On?
NO
Notify Master site
YES
Hear fan?
NO
Notify Master site
YES
Record failure code and press any key
Testing or op mode displayed ?
NO
Failure code displayed ?
NO
Notify Master site
YES
Alarm LED On?
YES
Notify Master site
Attach audio line
Attach DTE equipment
Enter desired FSK rate or leave at default
Record modem's serial number
Notify Master site

Figure 5-15. Nontechnical Remote Installation

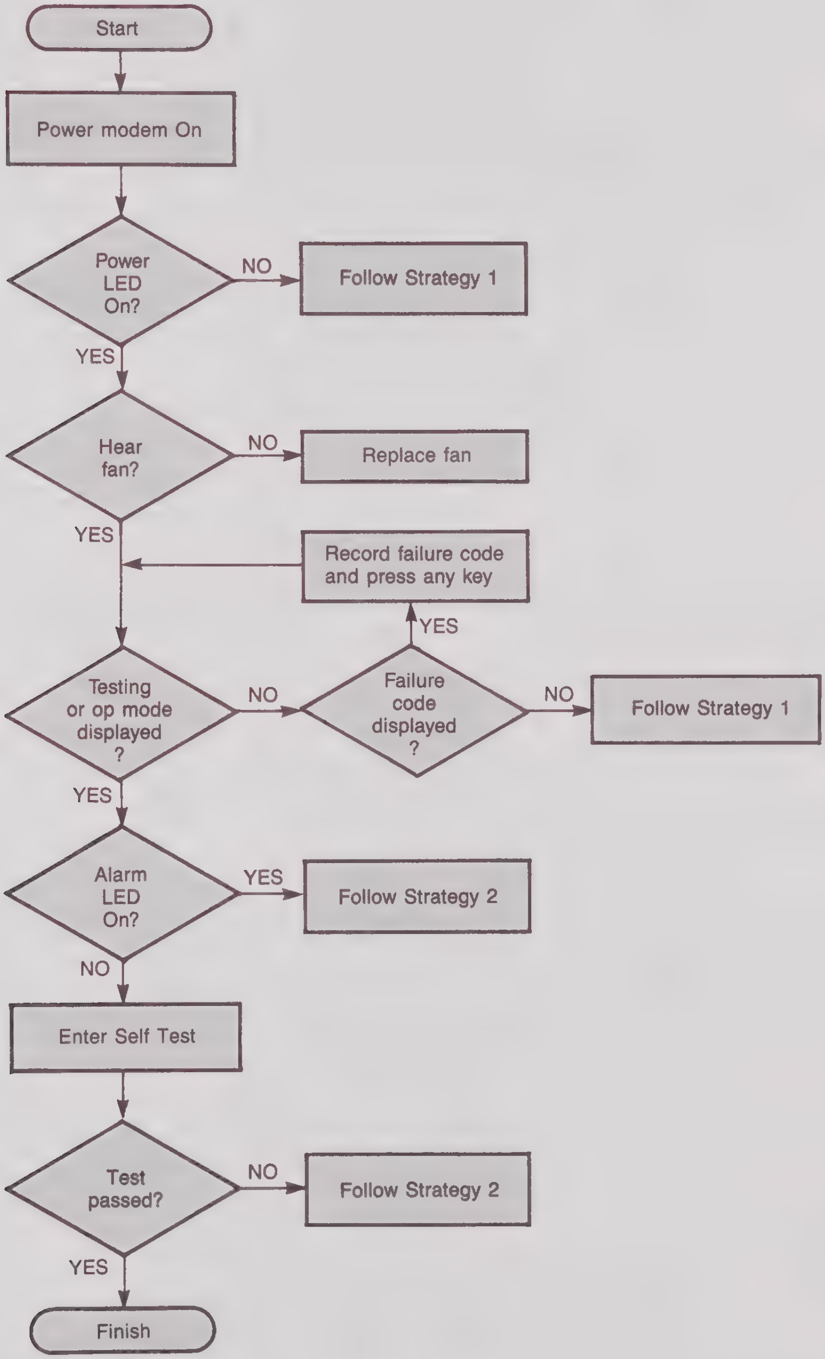

Start
Power modem On
Power LED On?
NO
Follow Strategy 1
YES
Hear fan?
NO
Replace fan
YES
Record failure code and press any key
YES
Testing or op mode displayed ?
NO
Failure code displayed ?
NO
Follow Strategy 1
YES
Alarm LED On?
YES
Follow Strategy 2
NO
Enter Self Test
Test passed?
NO
Follow Strategy 2
YES
Finish

Figure 5-16. Modem Confidence Check

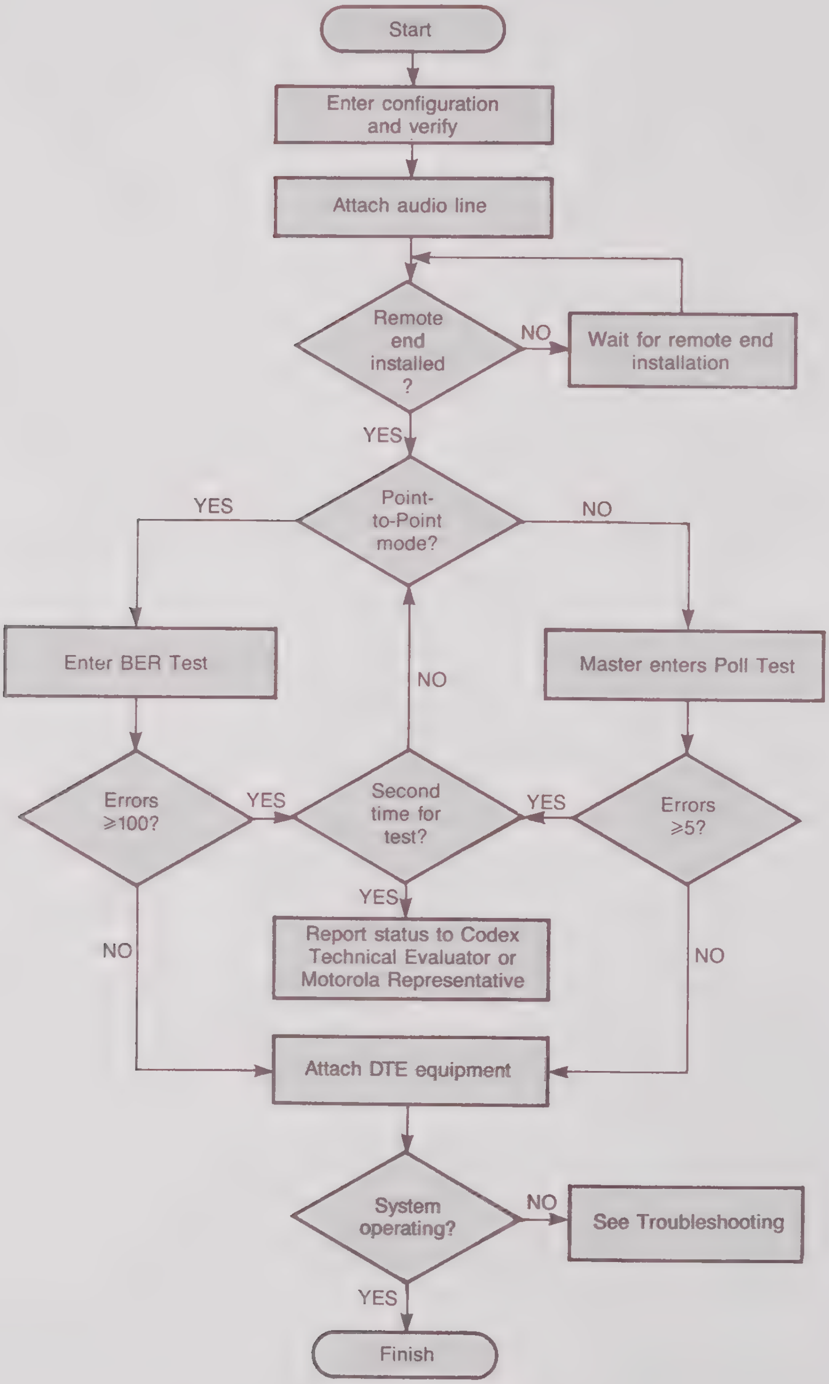

Start
Enter configuration and verify
Attach audio line
Remote end installed ?
NO
Wait for remote end installation
YES
Point-to-Point mode?
YES
NO
Enter BER Test
Master enters Poll Test
NO
Errors ≥100?
YES
Second time for test?
YES
Errors ≥5?
YES
Report status to Codex Technical Evaluator or Motorola Representative
NO
NO
Attach DTE equipment
System operating?
NO
See Troubleshooting
YES
Finish

Figure 5-17(A). Preoperational Check

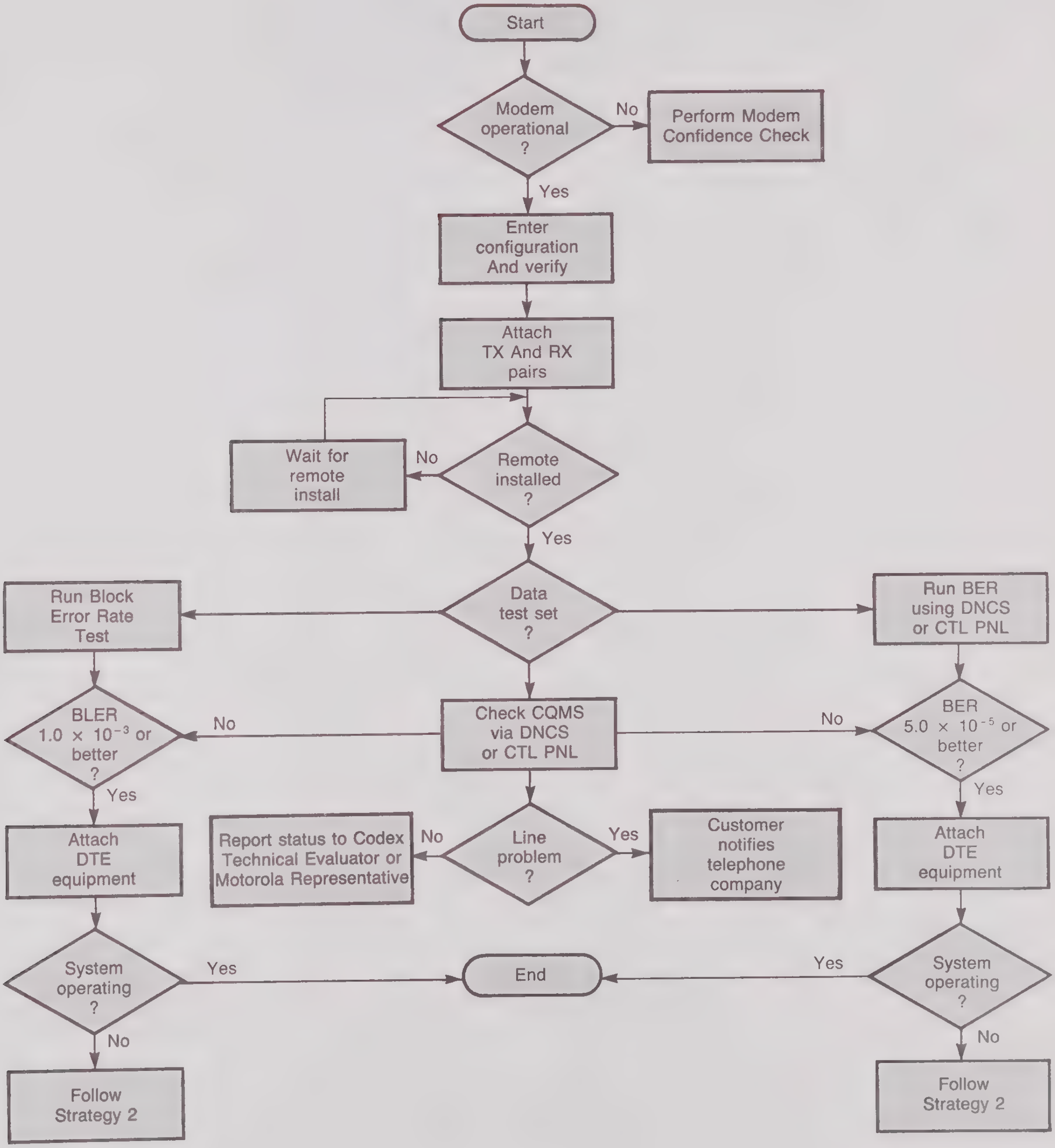

Start
Modem operational ?
No
Perform Modem Confidence Check
Yes
Enter configuration And verify
Attach TX And RX pairs
Wait for remote install
No
Remote installed ?
Yes
Run Block Error Rate Test
Data test set ?
Run BER using DNCS or CTL PNL
BLER 1.0 × 10⁻³ or better ?
No
Check CQMS via DNCS or CTL PNL
No
BER 5.0 × 10⁻⁵ or better ?
Yes
Yes
Attach DTE equipment
Report status to Codex Technical Evaluator or Motorola Representative
No
Line problem ?
Yes
Customer notifies telephone company
Attach DTE equipment
System operating ?
Yes
End
Yes
System operating ?
No
No
Follow Strategy 2
Follow Strategy 2

Figure 5-17(B). Preoperational Check for TCM Modems

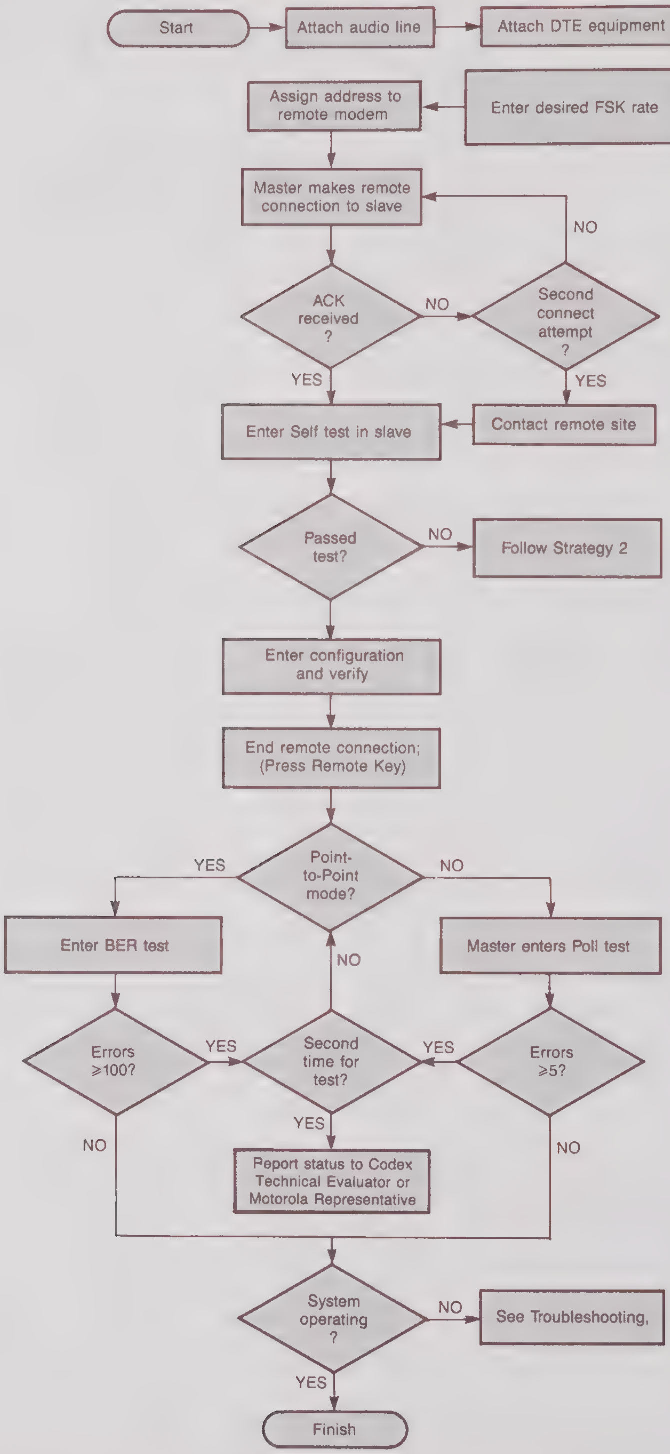

Start
Attach audio line
Attach DTE equipment
Enter desired FSK rate
Assign address to remote modem
Master makes remote connection to slave
ACK received ?
NO
Second connect attempt ?
NO
YES
YES
Enter Self test in slave
Contact remote site
Passed test?
NO
Follow Strategy 2
Enter configuration and verify
End remote connection; (Press Remote Key)
Point-to-Point mode?
YES
NO
Enter BER test
Master enters Poll test
NO
Errors ⩾100?
YES
Second time for test?
YES
Errors ⩾5?
YES
NO
NO
Peport status to Codex Technical Evaluator or Motorola Representative
System operating ?
NO
See Troubleshooting,
YES
Finish

Figure 5-18. Central Site Preoperational Check

Troubleshooting Flowcharts

This section consists of troubleshooting schemes for three types of modem configurations: point-to-point, master, and slave. Tables 5-2 through 5-4 list possible trouble indicators by priority. For example, in a point-to-point application, the ALARM LED on has priority over DCD off or flashing . Adherence to the priority scheme will dictate which troubleshooting strategy you should follow first.

Also provided in this section is a Voltage Check chart. If a failed card has been replaced and the ALARM condition continues, perform a voltage check, noting your readings in the chart provided. ■ **Note:** Some LEDs are not listed as problem indicators even though each could be a likely indicator of the problem. They are as follows: TXD, RXD, RTS, CTS, DSR, DTR, FLBK, and TEST. These LEDs are not listed on the chart because they are user-generated or respond to user-generated actions.

The LEDs listed as trouble indicators are characteristic of the typical configuration although variations will occur. For example, in a point-to-point application, DCD flashing could indicate dropouts. However, if the modem was strapped for Controlled Carrier or Control Signaling, DCD flashing would be the expected indication.

Therefore, you should know your modem configuration and the resultant effects of the configuration.

Point-to-Point Trouble Indicators

The possible trouble indicators for a point-to-point application are listed in Table 5-2; these direct you to the appropriate strategy.

Table 5-2.
Point-to-Point Trouble Indicators

Priority	*Indicator*	*Strategy*
1	No LEDs on	Modem Confidence Check, Figure 5-16
2	ALARM LED on	2, Figure 5-20
3	DCD off or flashing	5, Figure 5-23
4	RSQ off or flashing	5, Figure 5-23
5	DSR off	7, Figure 5-25

Multipoint Slave Trouble Indicators

Table 5-3 lists the possible trouble indicators for a multipoint slave modem; these direct you to the appropriate strategy.

Table 5-3.
Multipoint Slave Trouble Indicators

Priority	*Indicator*	*Strategy*
1	No LEDs On	Modem Confidence Check, Figure 5-16
2	ALARM LED On	8, Figure 5-26
3	DCD Off or Flashing	8, Figure 5-26
4	RSQ Off or Flashing	8, Figure 5-26

Multipoint Master Trouble Indicators

Table 5-4 lists the possible trouble indicators for a multipoint master modem; these direct you to the appropriate strategy.

Table 5-4.
Multipoint Master Trouble Indicators

Priority	*Indicator*	*Strategy*
1	No LEDs On	Modem Confidence Check, Figure 5-16
2	ALARM LED On	2, Figure 5-20
3	DCD Off or Flashing	10, Figure 5-28

As you follow the troubleshooting flowcharts, you will be directed at times to other flowcharts in pursuit of problem remedies. The following is a list of these flowcharts:

Figure 5-19, Strategy 1
Figure 5-20, Strategy 2
Figure 5-21, Strategy 3
Figure 5-22, Strategy 4
Figure 5-23, Strategy 5
Figure 5-24, Strategy 6
Figure 5-25, Strategy 7
Figure 5-26, Strategy 8
Figure 5-27, Strategy 9
Figure 5-28, Strategy 10
Figure 5-29, Strategy 11

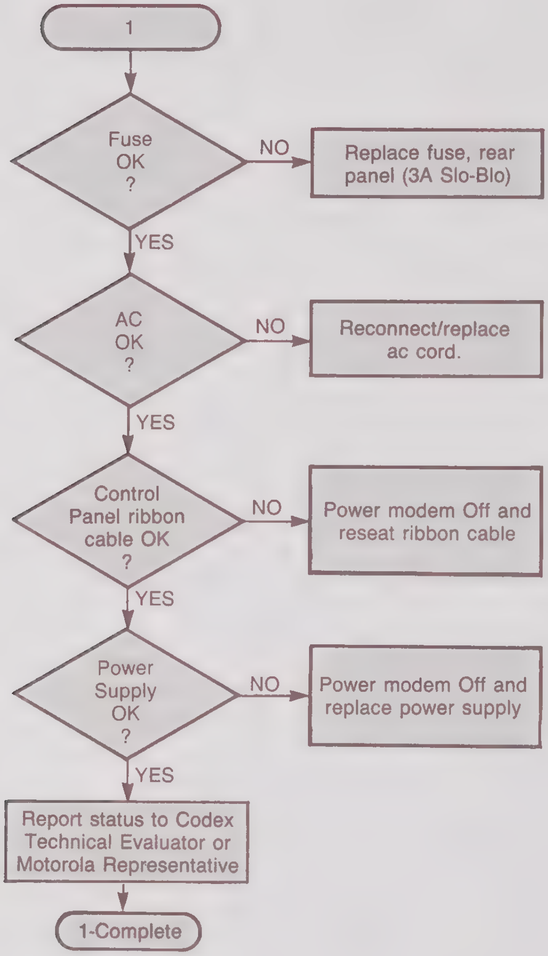

1
Fuse OK ?
NO
Replace fuse, rear panel (3A Slo-Blo)
YES
AC OK ?
NO
Reconnect/replace ac cord.
YES
Control Panel ribbon cable OK ?
NO
Power modem Off and reseat ribbon cable
YES
Power Supply OK ?
NO
Power modem Off and replace power supply
YES
Report status to Codex Technical Evaluator or Motorola Representative
1-Complete

Figure 5-19. Strategy 1

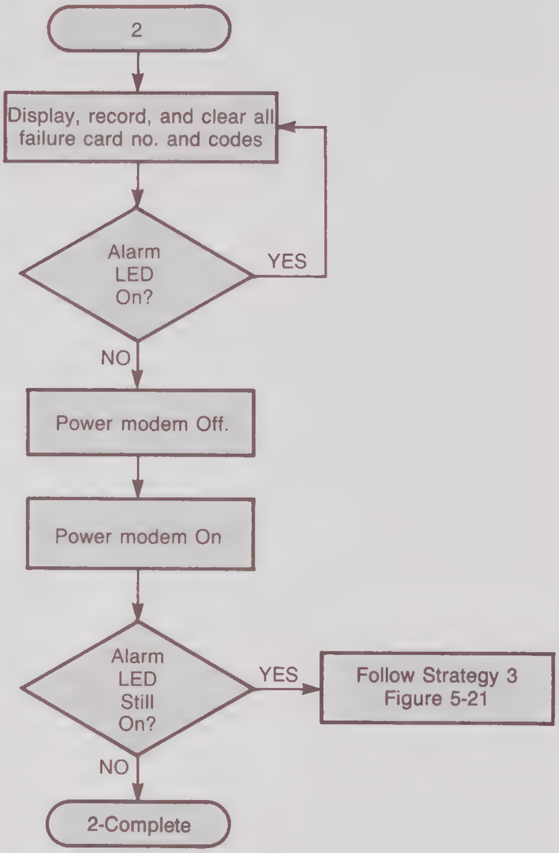

2
Display, record, and clear all failure card no. and codes
Alarm LED On?
YES
NO
Power modem Off.
Power modem On
Alarm LED Still On?
YES
Follow Strategy 3 Figure 5-21
NO
2-Complete

Figure 5-20. Strategy 2

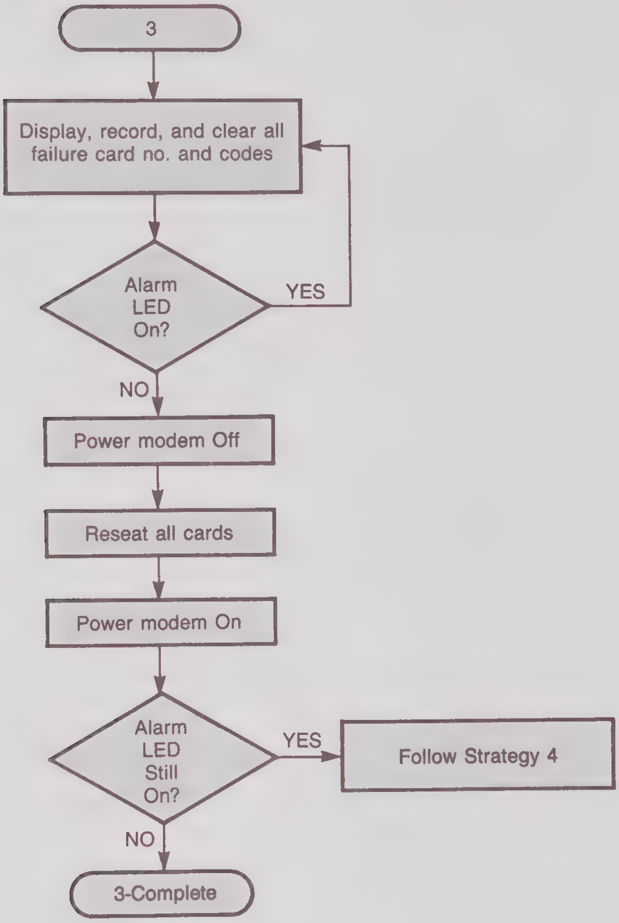

3
Display, record, and clear all failure card no. and codes
Alarm LED On?
YES
NO
Power modem Off
Reseat all cards
Power modem On
Alarm LED Still On?
YES
Follow Strategy 4
NO
3-Complete

Figure 5-21. Strategy 3

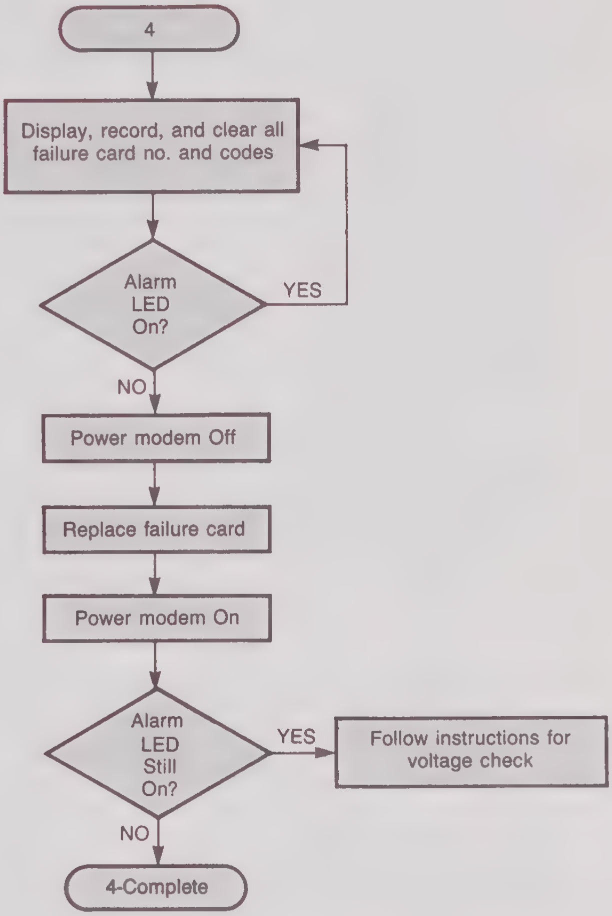

4
Display, record, and clear all failure card no. and codes
Alarm LED On?
YES
NO
Power modem Off
Replace failure card
Power modem On
Alarm LED Still On?
YES
Follow instructions for voltage check
NO
4-Complete

Figure 5-22. Strategy 4

■ **Note:** Strategy 5 should be performed at central site.

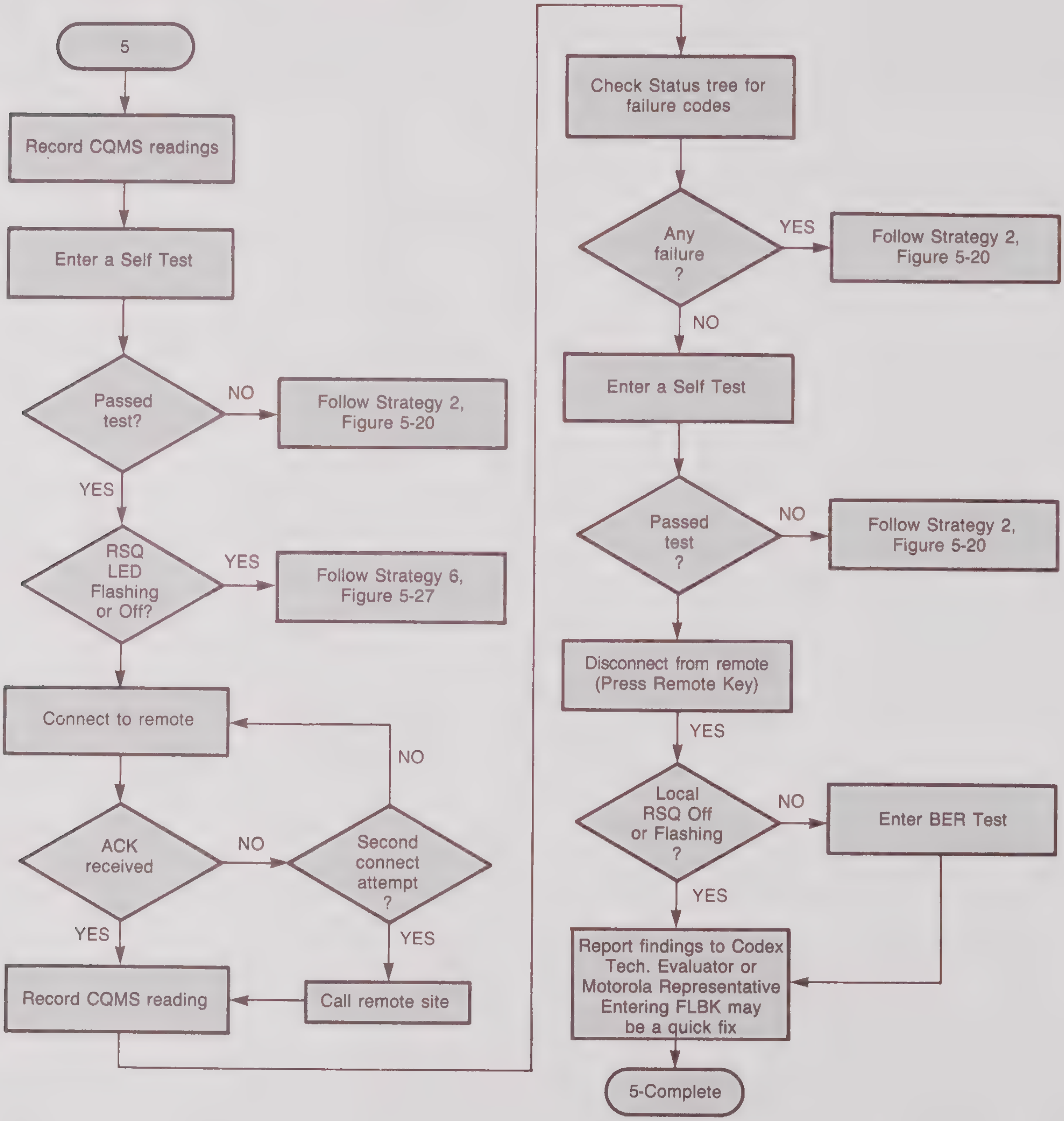

5
Record CQMS readings
Enter a Self Test
Passed test?
NO
Follow Strategy 2, Figure 5-20
YES
RSQ LED Flashing or Off?
YES
Follow Strategy 6, Figure 5-27
Connect to remote
ACK received
NO
Second connect attempt ?
NO
YES
YES
Record CQMS reading
Call remote site
Check Status tree for failure codes
Any failure ?
YES
Follow Strategy 2, Figure 5-20
NO
Enter a Self Test
Passed test ?
NO
Follow Strategy 2, Figure 5-20
Disconnect from remote (Press Remote Key)
YES
Local RSQ Off or Flashing ?
NO
Enter BER Test
YES
Report findings to Codex Tech. Evaluator or Motorola Representative Entering FLBK may be a quick fix
5-Complete

Figure 5-23. Strategy 5

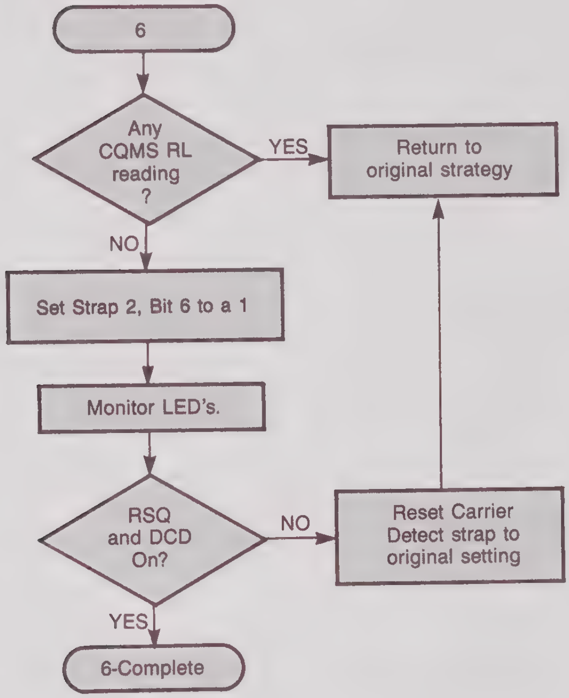

6
Any CQMS RL reading ?
YES
Return to original strategy
NO
Set Strap 2, Bit 6 to a 1
Monitor LED's.
RSQ and DCD On?
NO
Reset Carrier Detect strap to original setting
YES
6-Complete

Figure 5-24. Strategy 6

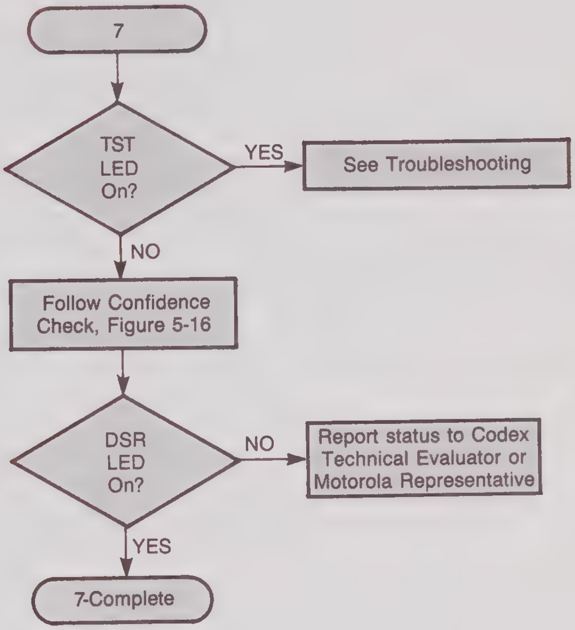

7
TST LED On?
YES
See Troubleshooting
NO
Follow Confidence Check, Figure 5-16
DSR LED On?
NO
Report status to Codex Technical Evaluator or Motorola Representative
YES
7-Complete

Figure 5-25. Strategy 7

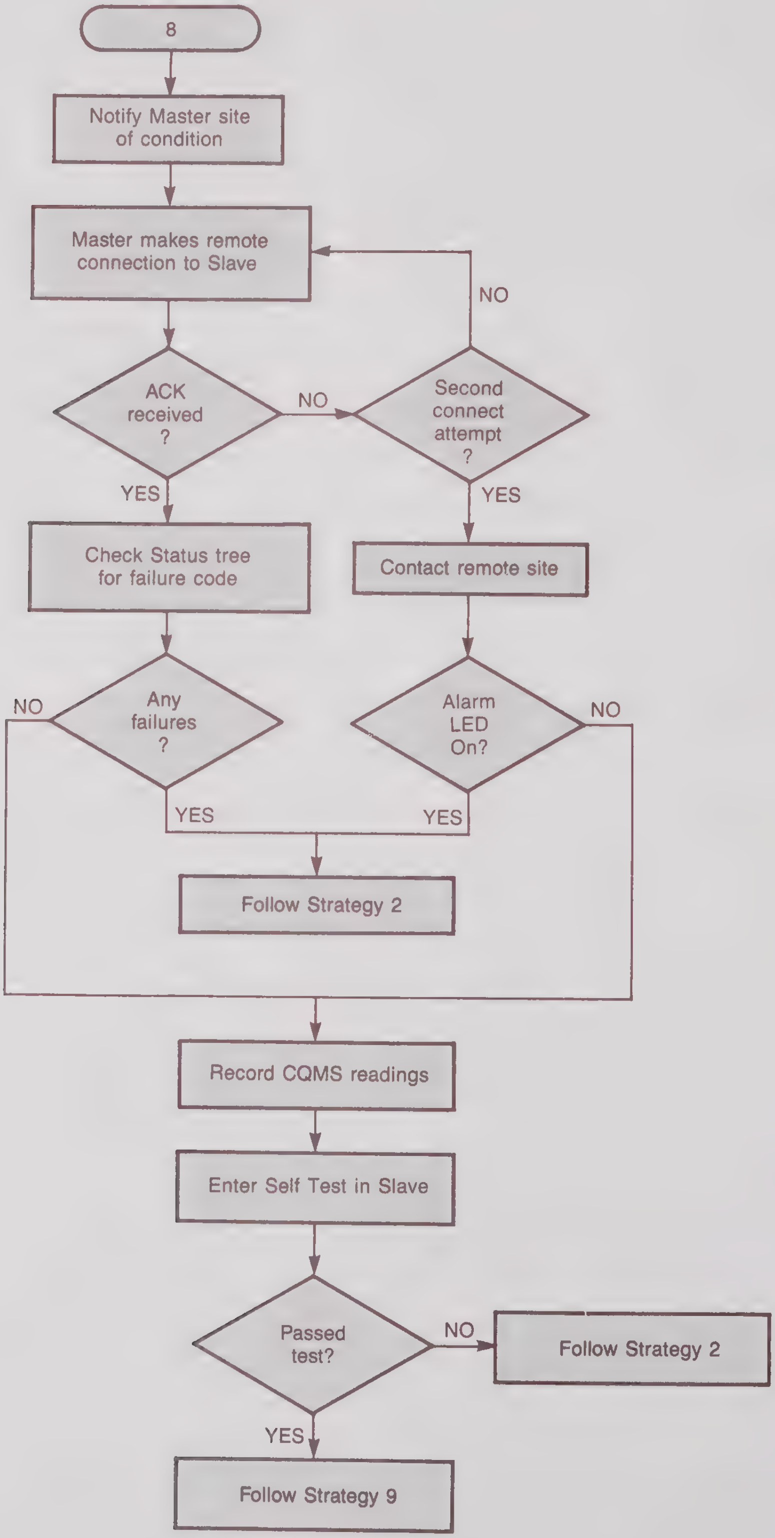

8
Notify Master site of condition
Master makes remote connection to Slave
ACK received ?
NO
Second connect attempt ?
NO
YES
YES
Check Status tree for failure code
Contact remote site
Any failures ?
NO
YES
Alarm LED On?
NO
YES
Follow Strategy 2
Record CQMS readings
Enter Self Test in Slave
Passed test?
NO
Follow Strategy 2
YES
Follow Strategy 9

Figure 5-26. Strategy 8

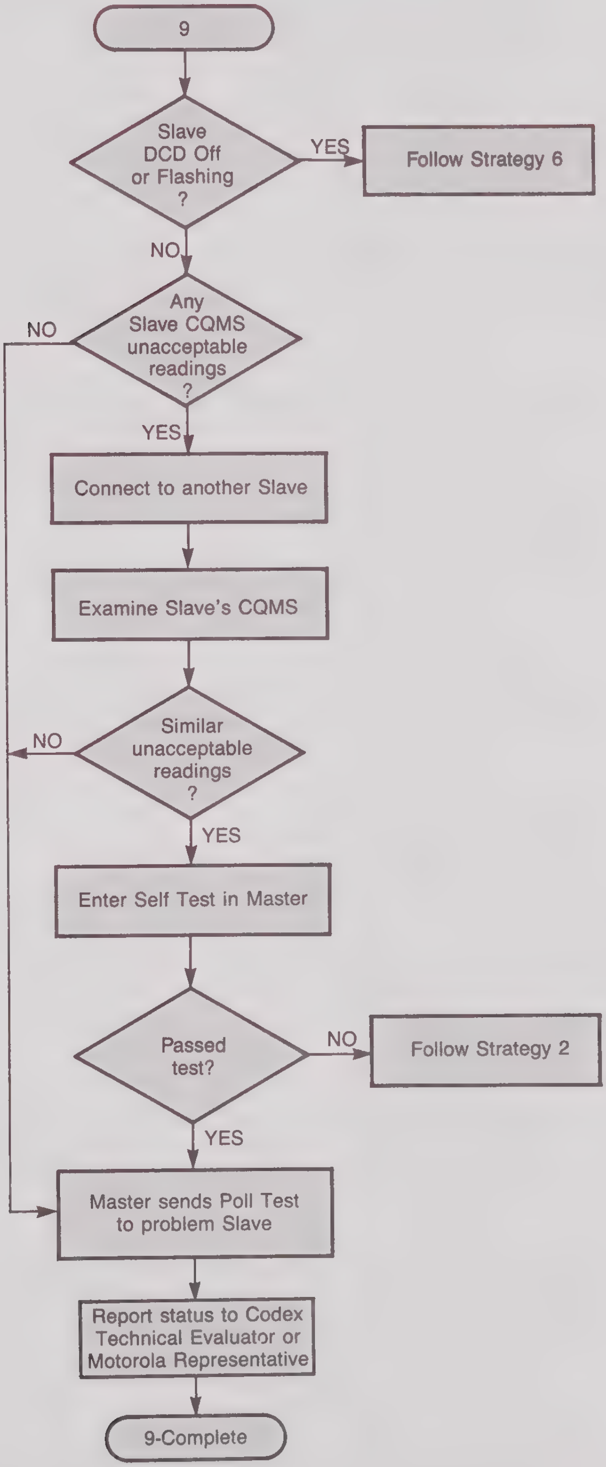

9
Slave DCD Off or Flashing ?
YES
Follow Strategy 6
NO
Any Slave CQMS unacceptable readings ?
NO
YES
Connect to another Slave
Examine Slave's CQMS
Similar unacceptable readings ?
NO
YES
Enter Self Test in Master
Passed test?
NO
Follow Strategy 2
YES
Master sends Poll Test to problem Slave
Report status to Codex Technical Evaluator or Motorola Representative
9-Complete

Figure 5-27. Strategy 9

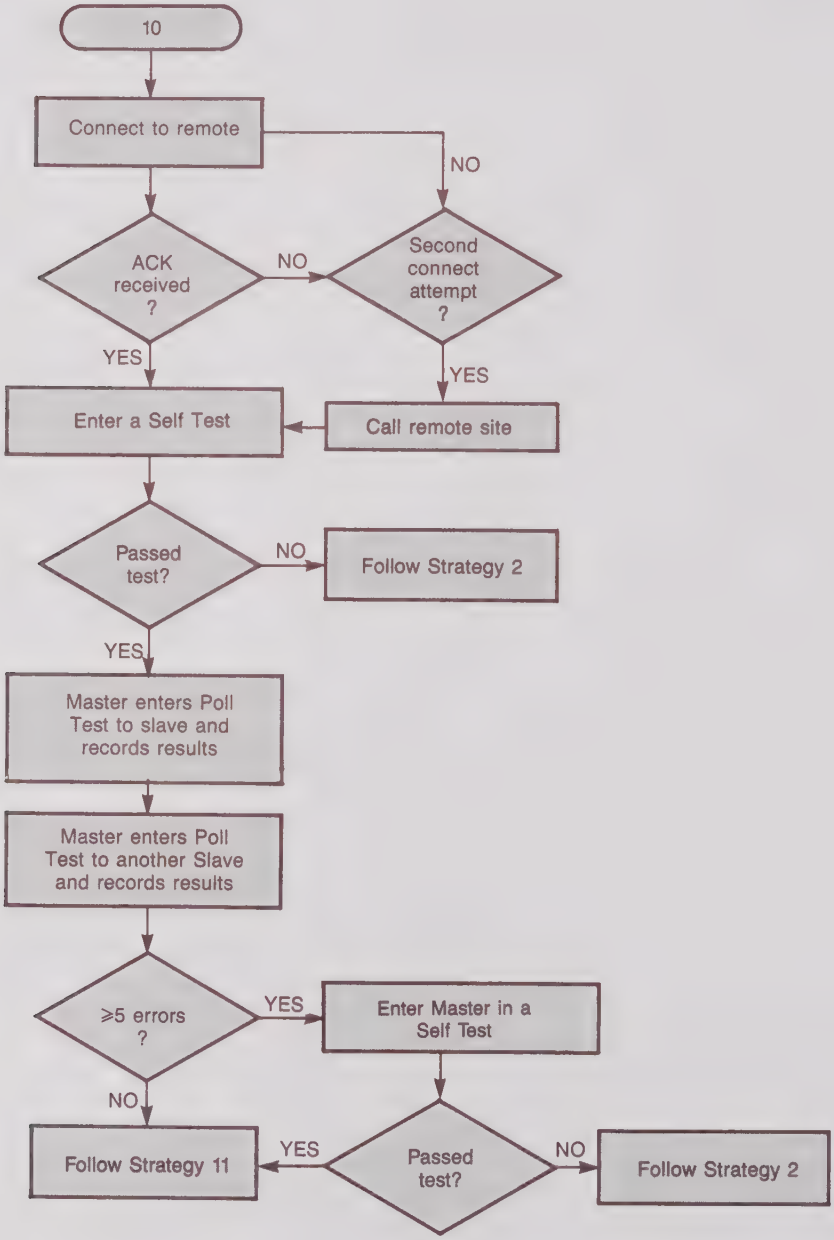

10
Connect to remote
NO
ACK received ?
NO
Second connect attempt ?
YES
YES
Enter a Self Test
Call remote site
Passed test?
NO
Follow Strategy 2
YES
Master enters Poll Test to slave and records results
Master enters Poll Test to another Slave and records results
⩾5 errors ?
YES
Enter Master in a Self Test
NO
Follow Strategy 11
YES
Passed test?
NO
Follow Strategy 2

Figure 5-28. Strategy 10

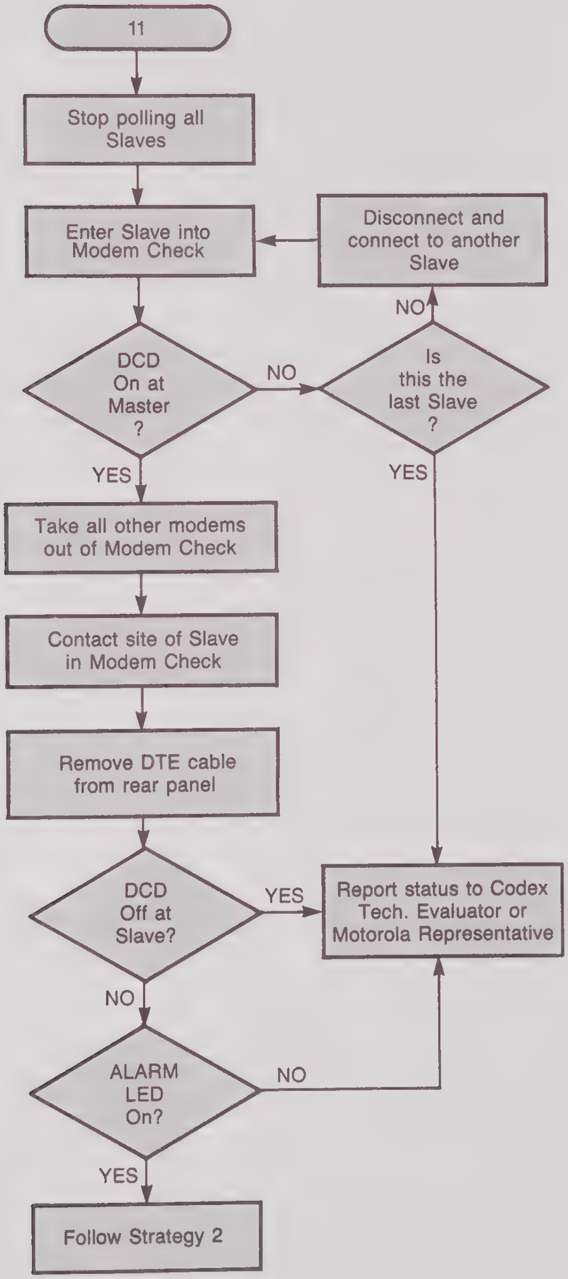

11
Stop polling all Slaves
Enter Slave into Modem Check
Disconnect and connect to another Slave
NO
DCD On at Master ?
NO
Is this the last Slave ?
YES
YES
Take all other modems out of Modem Check
Contact site of Slave in Modem Check
Remove DTE cable from rear panel
DCD Off at Slave?
YES
Report status to Codex Tech. Evaluator or Motorola Representative
NO
ALARM LED On?
NO
YES
Follow Strategy 2

Figure 5-29. Strategy 11

Voltage Check

The power supply accepts alternating current from the AC power source and converts it to direct current. These DC voltages are passed through the input/output (I/O) panel to the circuit cards. Because of this current path, a failure may be displayed as a card failure when the actual cause may be the I/O panel or the power supply.

When an identified circuit card has been replaced and it continues to display as a failure, follow these steps:

1) Power the modem off and remove the Data Pump card. Attach the card extender to the Data Pump card and reseat it in the modem. Power the modem on.

2) Record each voltage from the Data Pump card (see Figure 5-30) on the Voltage Chart (see Table 5-5).

3) Power the modem off and remove the DTE card. Attach the card extender to the DTE card and reseat it in the modem. Power the modem on.

4) Record each voltage from the DTE card (see Figure 5-31) on the Voltage Chart. ■ **Note:** Acceptable voltages are ±0.5 volt.

5) Power the modem off; remove the 19.2 Expansion card from the A1 or A4 slot and the DDR card from the A1 slot if DDR has been installed. Attach the DDR card extender to the 19.2 Expansion card; reseat it into the A1 slot in the modem.

6) Record each voltage from the 19.2 Expansion card (see Figure 5-32) on the voltage chart in Table 5-5.

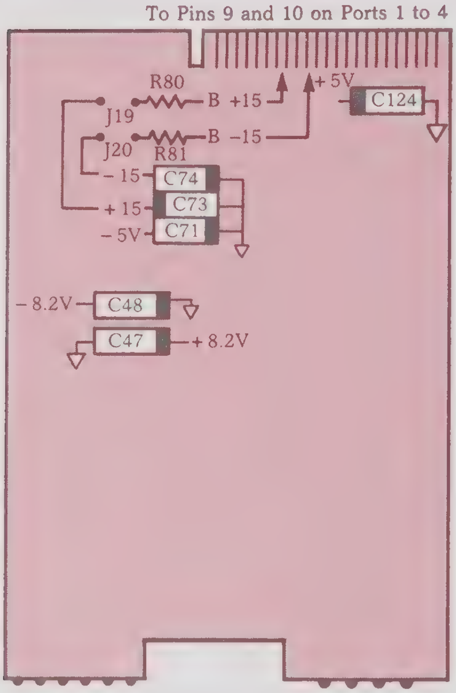

To Pins 9 and 10 on Ports 1 to 4
R80
J19
B +15
+5V
C124
J20
R81
B −15
−15
C74
+15
C73
−5V
C71
−8.2V
C48
C47
+8.2V

Figure 5-30. Data Pump Card Voltage Checks

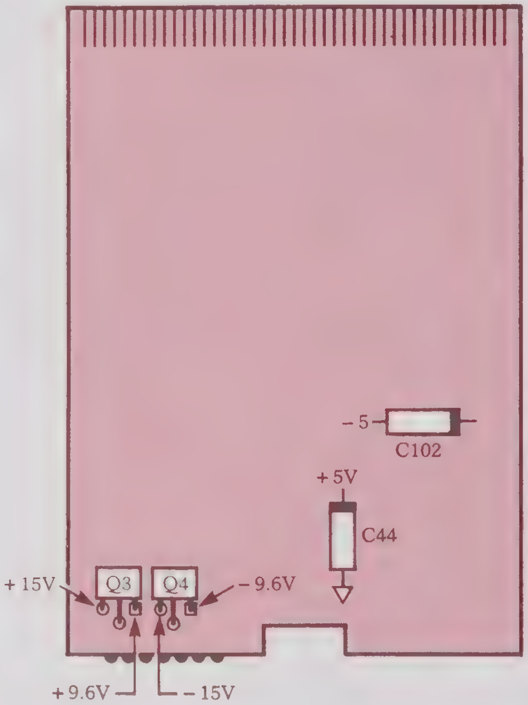

−5
C102
+5V
C44
+15V
Q3
Q4
−9.6V
+9.6V
−15V

Figure 5-31. DTE Card Voltage Checks

Table 5-5.
Voltage Check

Row	*Acceptable Voltages for All Cards*	*Component Data Pump Location*	*Data Pump Voltages*	*Component DTE Location*	*DTE Voltages*	*Component Expansion Card Location*	*Expansion Card Voltages*
1	+5	C-124	________	C-44	________	C-76	________
2	−5	C-71	________	C-102	________	C-40	________
3	+15	C-73	________	Q3	________	C-44	________
4	−15	C-74	________	Q4	________	C-42	________
5	+8.2/9.6	C-47	________	Q3	________	N/A	N/A
6	−8.2/9.6	C-48	________	Q4	________	N/A	N/A

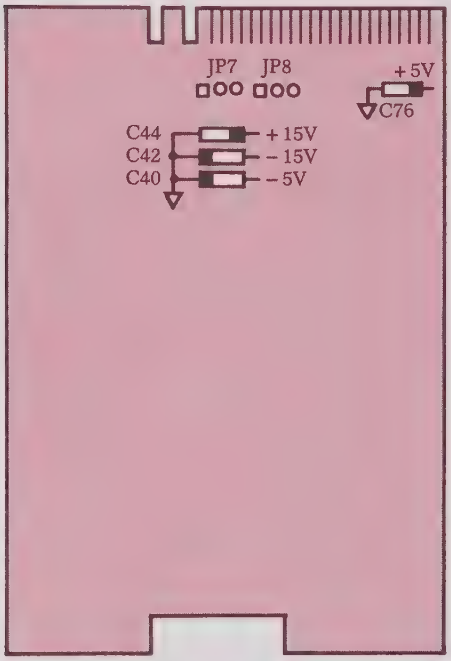


Figure 5-32. Expansion Card Voltage Checks

Based on the voltage readings, take the following actions:

7) If all voltages are acceptable, the I/O panel and power supply are operating satisfactorily.

8) If two voltages (three voltages in the 19.2) in any row are unacceptable, power off the modem, replace the power supply (see the Repair/Replacement section in Chapter 6), and remeasure all voltages. If readings remain unacceptable, the I/O panel is defective.

9) If the Data Pump voltage is acceptable but the DTE voltage is unacceptable for any row, power off the modem, replace the DTE card (see the Repair/Replacement section in Chapter 6), and remeasure all voltages. If readings remain unacceptable, the I/O panel is defective.

10) If the Data Pump voltage is unacceptable but the DTE voltage is acceptable for any row, power off the modem, replace the Data Pump card (see the Repair/Replacement section in Chapter 6), and remeasure all voltages. If the reading remains unacceptable, the I/O panel is defective.

11) If the Expansion card voltage is unacceptable but the Data Pump voltage and the DTE voltage are acceptable for any row, power off the modem, replace the Expansion card, and remeasure all voltages. If the reading remains unacceptable, the I/O panel is defective.

12) For further information, consult with the Codex Technical Evaluator. If you are a customer outside the U.S.A., consult with your nearest Motorola representative.

Chapter 6
Maintenance

Contents

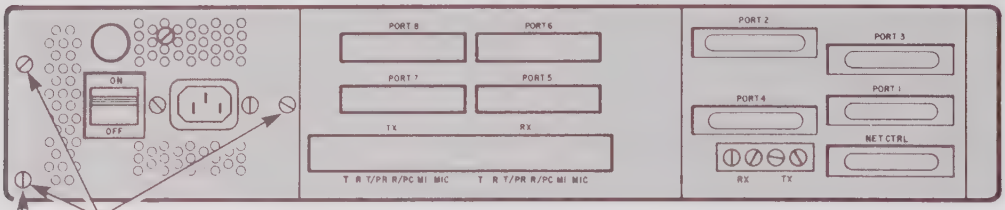
General 6-1
Repair/Replacement 6-2
  Replacing the Fan Assembly 6-2
  Replacing the Power Supply 6-2
  Replacing Printed Circuit (PC) Card 6-4

GENERAL

The 2600 Series Modem should provide totally maintenance-free service. Occasionally, you may need to remove whatever dust may have settled on or in the unit. Use a soft brush to remove dust that may have built up on electrical components. Remove dust that may have built up on the outside of the unit with a soft cloth.

> *WARNING*
>
> Disconnect AC power and audio lines before performing any maintenance on the unit. Disconnect the power to ensure that no potential electric shock hazard could be present.

■ **CAUTION:** *Follow proper static electricity control procedures when servicing the unit to avoid damaging the circuits.*



Remove these three screws to access fan assembly.

Thread-forming screw; use caution when removing and installing. Be sure to return the thread-forming screw to this location only.

Figure 6-1. Gaining Access to Fan Assembly

REPAIR/REPLACEMENT

Field repair of defective modules or components is not recommended. However, if a whole module is defective, you should replace it quickly to return the unit to online service.

The replaceable modules in the 2600 Series are the fan, power supply, and printed circuit cards. The following sections discuss procedures for replacing these modules.

Replacing the Fan Assembly

You can gain access to the fan assembly through the rear panel of the modem. To replace the fan, remove the three screws shown in Figure 6-1. Note that the lower left screw is a thread-forming screw and must be returned to the same location. Slide the fan module out and rotate it to the left, as shown in Figure 6-2. A short cable is now visible. To disconnect the cable from the bulkhead mounted connector, move the locking tab to the right and then unplug the cable, freeing the entire assembly.

To install the new assembly, reverse these steps. Replace the thread-forming screw to the same location from which it was removed.

Replacing the Power Supply

The power supply is located in the front of the modem. To gain access to the power supply, first open the Control Panel, as shown in Figure 6-3. The power supply is on the right of the printed circuit cards. Remove the power supply by turning the screw in the upper-right corner several turns counterclockwise. This releases the power supply's locking mechanism, allowing you to slide out the power supply.

When replacing the power supply, be sure to set the metal chassis properly in its tracks; then slide it securely back into place. Turn the screw clockwise to lock the power supply in place.

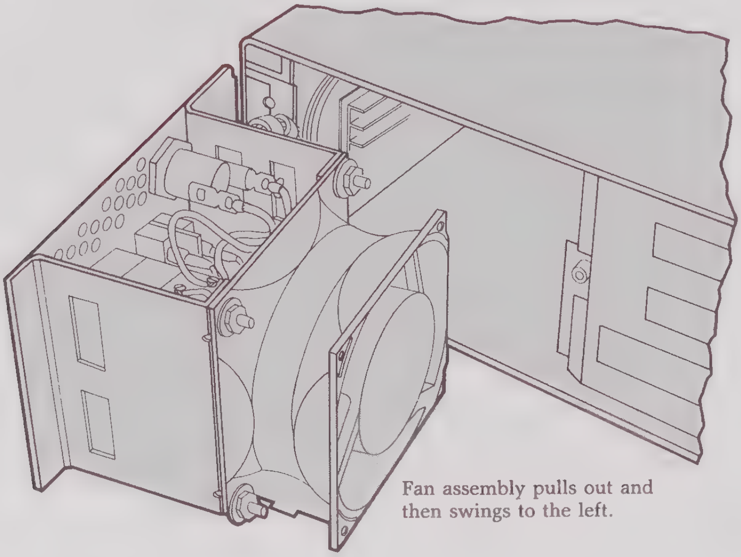

Fan assembly pulls out and
then swings to the left.

Figure 6-2. Removing the Fan

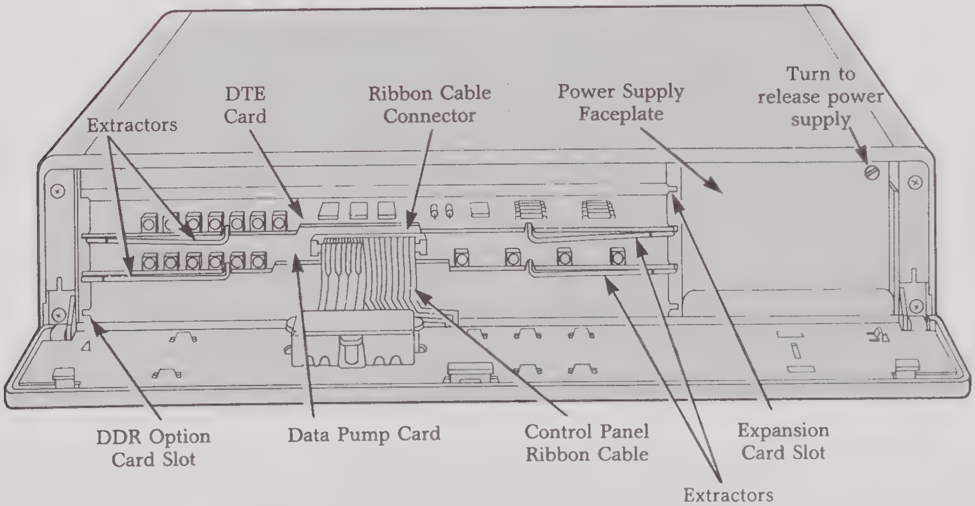

Extractors
DTE Card
Ribbon Cable Connector
Power Supply Faceplate
Turn to release power supply
DDR Option Card Slot
Data Pump Card
Control Panel Ribbon Cable
Expansion Card Slot
Extractors

Figure 6-3. Front View with Control Panel Down

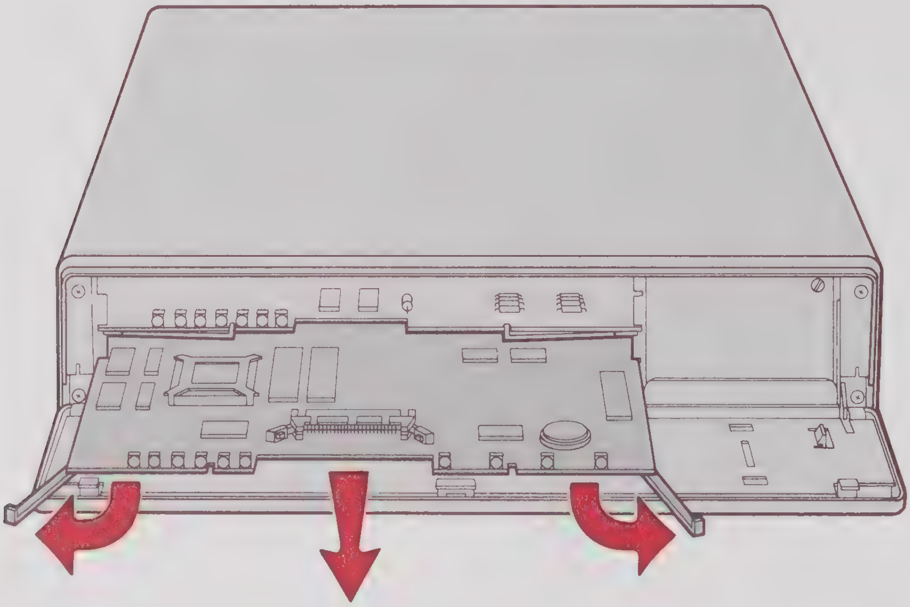


Figure 6-4. Removing the PC Card

Replacing Printed Circuit (PC) Cards

Before replacing the PC cards, record configuration information on the worksheets in Chapter 3.

■ **CAUTION:** *When disconnecting the Control Panel ribbon cable from the Data Pump card, be sure that the AC power cord has been disconnected. Failure to disconnect the AC power cord could result in damage to the Control Panel display.*

You can access the Printed Circuit (PC) cards through the front of the modem after first opening down the Control Panel. There are currently three PC cards available in the 2600 Series Modem: Data Pump card, DTE card, and the Dual Dial Restoral (DDR) option card. Their locations within the modem are shown in Figure 6-3.

Frequently, the cause of a failure is that the PC card is not seated properly in the modem. Therefore, before replacing the card, turn the power off, reseat the card, and try again. To reseat or replace the Data Pump and DTE cards, first power down the unit, pull the two extractors on both sides of the card towards you, as shown in Figure 6-4, and then slide the card out.

The Control Panel ribbon cable is attached to the Data Pump card (refer to Figure 6-3). To remove the ribbon cable from the Data Pump card, first release the card and then unsnap the sides of the ribbon cable connector. When you replace the Data Pump card, be sure that the ribbon cable is seated properly and secured in the connector.

The extractors also act as inserters to overcome connector insertion forces. Be sure to engage extractors correctly before seating the card.

To replace the DDR card, power down the unit and remove the Control Panel ribbon cable as was done on the Data Pump card. Remove the entire front door from the unit by pulling firmly on the door, away from the unit. Use the extractors as before to remove and reinstall the DDR card. The door assembly may be reinstalled by engaging the hinge pins into the door mounts and pushing firmly into place. Reinstall the Control Panel cable as previously instructed.

Chapter 7
Return Procedures

Contents

Equipment Return Procedures 7-1
Expiration of Lease 7-2
Factory Repair 7-2
Service Replacement 7-2
Questions about Equipment Return Procedures 7-2
Repackaging Guidelines for Equipment Return 7-2
Specific Packaging Guidelines 7-3
Exceptions to Packaging Guidelines 7-3
District and Regional Codex Sales Offices .. 7-3
Regional Codex Customer Service Offices ... 7-6

EQUIPMENT RETURN PROCEDURES

If you are returning equipment to a location outside the United States, contact your nearest Motorola representative. Otherwise, use the guidelines in this chapter.

Equipment returns to Codex fall under one of three categories: expiration of lease, factory repair, or service replacement. These categories and their equipment return guidelines are explained in the following sections.

Expiration of Lease

Customers who return equipment to Codex on expiration of the lease period should contact their district or regional Codex Sales Office for return authorization and instructions. A list of these offices follows. When you contact the sales office, you will be asked to provide the following information:

- Product name and description
- Serial number
- Customer order number
- Reason for return

Factory Repair

Customers who return equipment to Codex for factory repair should telephone the Codex Return Service Coordinator at Mansfield, Massachusetts, (617) 364-2000, extension 3906, for return authorization and instructions. When you call Codex, you will be given a Return Material Authorization (RMA) control number. Mark this number clearly on the shipping container for ease of identification and faster service. The RMA control number is simply a shipment-control tool and does not affect the provisions of a sales or lease agreement. You will then be asked to provide the following information for each piece of equipment you return:

- Product name and description
- Serial number
- Customer order number
- Failure symptoms

Service Replacement

Any defective equipment and parts that were previously replaced by Codex Customer Service should be returned to the same regional service office that originally replaced the item. A list of regional Codex Customer Service Offices follows.

QUESTIONS ABOUT EQUIPMENT RETURN PROCEDURES

Customers who have questions about equipment return procedures should call the Codex Return Service Coordinator, (617) 364-2000, extension 3906, for advice and assistance. Customers who require either on-site service or unit-exchange service should telephone their regional Codex Customer Service Office for information and instructions.

REPACKAGING GUIDELINES FOR EQUIPMENT RETURN

Data communications equipment or parts that are to be returned to Codex for any reason must be properly packaged to prevent damage in shipment and handling.

If the original packing material and shipping container are available, reuse these items to return equipment. If these items are not available, package the equipment for shipment as follows.

- Secure movable and exposed parts before shipment so they will not become loose in shipment and cause damage or be damaged.

- Package cathode ray tubes (CRTs) and other fragile items securely in approximately 4 inches (10.2 cm) of foam cushioning, and enclose them in the original shipping container. If the original container is not available, obtain a suitable container from a shipping/packaging vendor.

- Do not use abrasive or dusty materials for cushioning.

- Ship all equipment in wooden crates or double-wall corrugated containers, or strap it to cushioned pallets. Package items weighing more than 18 pounds (8.2 kg) in double-wall or stronger containers.

- Use internal cushioning in conjunction with wooden crates to prevent the contents from shifting in the crate and suffering external mechanical damage or internal shock damage.

- When you return more than one item in the same shipping container, wrap each unit separately in at least 1/2-inch (1.27-cm) air-cell (bubble-pack) material and package it in a corrugated single-wall container. The package can then be shipped in a double-wall container with other similarly packaged items.

- Place each printed circuit (PC) card in an individual conductive bag, wrap the PC card in a double layer of 3/16-inch (0.48-cm) air-cell (bubble-pack) material, and ship it in a corrugated double-wall container. Alternatively, put each PC card in an individual conductive bag and then place it between layers of convoluted urethane foam in a shipping folder, only one PC card per folder.

Specific Packaging Guidelines

If the original packing material and shipping container are not available to use in returning equipment to Codex, package the item as described below.

- ***Preferred.*** Return the equipment in its original packing material and shipping container.
- ***Alternative.*** Wrap the equipment in sufficient 1/2-inch (1.27-cm) air-cell (bubble-pack) material to provide at least 2 inches (5 cm) of cushioning, and enclose it in a double-wall shipping container. You may also enclose the equipment in a bag, cushion it in at least 3 inches (7.6 cm) of foam-in-place and ship it in a double-wall container.
- ***Minimally Acceptable.*** Enclose the equipment in a bag, cushion it in at least 4 inches (10.2 cm) of flowable material such as expanded polystyrene (EPS) beads, and ship it in a double-wall shipping container.

Exceptions to Packaging Guidelines

The Codex Return Service Coordinator is available to answer your questions about packaging requirements. If you believe that packaging is required that deviates from the guidelines given above, please call the Codex Return Service Coordinator, Codex Corporation, Mansfield, Massachusetts, (617) 364-2000, extension 3906, for advice and assistance. Exceptions to these guidelines are allowed only with the permission of the Return Service Coordinator.

DISTRICT AND REGIONAL CODEX SALES OFFICES

ALABAMA

2820 Columbiana Road
Suite 210M
Birmingham, AL 35216
Tel: (205) 979-0355

ALASKA

3601 C Street
Suite 200
Anchorage, AK 99503
Tel: (907) 562-3204

ARIZONA

8902 N. Central Avenue
Suite 101
Phoenix, AZ 85020
Tel: (602) 944-6940

CALIFORNIA

500 Airport Boulevard
Suite 200
Burlingame, CA 94010
Tel: (415) 342-9741

5001 Airport Plaza Drive
Suite 150
Long Beach, CA 90815
Tel: (213) 421-0086

6701 Fourth Avenue
Suite 100
Sacramento, CA 95817
Tel: (916) 451-3007

5333 Mission Center Road
Suite 344
San Diego, CA 92108
Tel: (619) 296-6283

17671 Irvine Boulevard
Suite 208
Tustin, CA 92680
Tel: (714) 838-5515

20720 Ventura Boulevard
Suite 340
Woodland Hills, CA 91364
Tel: (818) 992-4004

COLORADO

7828 Vance Drive
Suite 280
Arvada, CO 80003
Tel: (303) 425-6345

CONNECTICUT

100 Western Boulevard
Salmonbrook Office Park
Glastonbury, CT 06033
Tel: (203) 633-9431/9432

30 Commerce Park
Milford, CT 06460
Tel: (203) 874-1965

FLORIDA

851 Douglas Avenue
Suite 117
Altamonte Springs, FL 32714
Tel: (404) 952-9330

2688 N.W. 99th Avenue
Coral Springs, FL 32714
Tel: (305) 344-8853

16109 W. Course Drive
Tampa, FL 33626
Tel: (813) 961-8323

GEORGIA

2121 Newmarket Parkway
Suite 130
Marietta, GA 30067
Tel: (404) 952-9330

HAWAII

See Tustin, California

IDAHO

355 N. Orchard
Suite 210
Boise, ID 83706
Tel: (208) 322-4800

ILLINOIS

150 N. Michigan Avenue
Suite 2100
Chicago, IL 60601
Tel: (312) 781-7320

1014 E. Algonquin Road
Suite 106
Schaumburg, IL 60195
Tel: (312) 576-2036

INDIANA

6525 E. 82nd Street SW
Suite 115
Indianapolis, IN 46250
Tel: (317) 842-7017

KANSAS

10000 W. 75th Street
Suite 106
Shawnee Mission, KS 66204
Tel: (913) 677-2002

LOUISIANA

3925 North I-10 Service Road
Suite 109-0
Metairie, LA 70002
Tel: (504) 885-7013

MARYLAND

Airport Square IV
939 Elkridge Landing Road
Suite 120
Linthicum, MD 21090
Tel: (301) 850-4546

MASSACHUSETTS

65 Dan Road
P.O. Box 469
Canton, MA 02021
Tel: (617) 821-1560

MICHIGAN

Sheffield Office Park
Suite 122
3310 W. Big Beaver Road
Troy, MI 48084
Tel: (313) 649-4230

MINNESOTA

8300 Norman Center Drive
Suite 560
Minneapolis, MN 55437
Tel: (612) 835-7927

MISSOURI

231 South Bemiston
Suite 1230
St. Louis, MO 63105
Tel: (314) 863-1900

NEBRASKA

1722 St. Mary's
Suite 216
Omaha, NB 68102
Tel: (402) 444-1645

NEW HAMPSHIRE

125 E. Dunstable Road
Nashua, NH 03062
Tel: (603) 880-4378

NEW JERSEY

777 Passaic Avenue
Clifton, NJ 07012
Tel: (201) 470-9001

Plaza Office Center
Suite 409
Route 73 and Fellowship Road
Mount Laurel, NJ 08054
Tel: (609) 235-5871

NEW YORK

708 Third Avenue
New York, NY 10017
Tel: (212) 557-2700

656 Kreag Road
Pittsford, NY 14534
Tel: (716) 223-7800

5158 Old Kings Highway
Saugerties, NY 12477
Tel: (914) 338-3332

NORTH CAROLINA

3707 Latrobe Drive
Suite 450
Charlotte, NC 28211
Tel: (704) 366-9600

4411 W. Market Street
Suite 200-B
Greensboro, NC 27407
Tel: (919) 855-3865

OHIO

8078 Beechmont Avenue
Cincinnati, OH 45230
Tel: (513) 474-4411

6500 Busch Boulevard
Suite 210
Columbus, OH 43229
Tel: (614) 436-2370

7123 Pearl Road
Suite 108
Middleburg Heights, OH 44130
Tel: (216) 886-4444

OKLAHOMA

7136 S. Yale
Suite 300
Tulsa, OK 74136
Tel: (918) 494-0126

508 W. Vandament
Suite 100
Yukon, OK 73099
Tel: (405) 354-2212

OREGON

7185 S.W. Sandburg Road
Suite 200
Tigard, OR 97223
Tel: (503) 620-7276

PENNSYLVANIA

500 Sainte Claire Plaza
Pittsburgh, PA 15241
Tel: (412) 941-4235

TENNESSEE

5115 Maryland Way
Suite 40
Brentwood, TN 37027
Tel: (615) 377-0740

1355 Lynnfield Road
Suite 245
Memphis, TN 38119
Tel: (901) 767-3010

TEXAS

8500 Mopac Expressway North
Suite 809
Austin, TX 78759
Tel: (512) 346-1941

9441 LBJ Freeway
Suite 214
Dallas, TX 75243
Tel: (214) 690-5221

8 Greenway Plaza
Suite 814
Houston, TX 77046
Tel: (713) 629-6910

UTAH

3285 E. Danforth
Salt Lake City, UT 84121
Tel: (801) 278-5402

VIRGINIA

1800 Diagonal Road
Suite 200
Alexandria, VA 22314
Tel: (703) 684-0400

7814 Carousel Lane
Suite 300
Richmond, VA 23229
Tel: (804) 747-1620

WASHINGTON

12835 Bellevue-Redmond Road
Suite 203
Bellevue, WA 98005
Tel: (206) 453-0510

WISCONSIN

10855 W. Potter Road
Wauwatosa, WI 53226
Tel: (414) 475-7533

REGIONAL CODEX CUSTOMER SERVICE OFFICES

CALIFORNIA

L.A. District/Western Region
5001 Airport Plaza Drive
Suite 150
Long Beach, CA 90815
Tel: (213) 421-0086

GEORGIA

Atlanta Region
2121 Newmarket Parkway
Suite 130
Marietta, GA 30067
Tel: (404) 952-1759

ILLINOIS

Midwest Region
1014 E. Algonquin Road
Suite 104
Schaumburg, IL 60195
Tel: (312) 576-2171

MASSACHUSETTS

Boston District/Northeast Region
65 Dan Road
P.O. Box 525
Canton, MA 02021
Tel: (617) 821-1690

NEW JERSEY

Eastern Region
777 Passaic Avenue
Clifton, NJ 07012
Tel: (201) 470-0775

TEXAS

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Glossary

This glossary defines terms used in data communications and in the *2600 Series User's Manual.*

ACK	Acknowledged; a message or block of data is received with no apparent errors. The transmitting equipment is now free to send another message or block.
ALARM ACK	Alarm acknowledged.
Alarm Monitor	Normal online monitor; monitors modems based upon threshold values. If operating conditions exceed the values, the modem generates an alarm report.
Analog	The continuous wave or signal (such as the human voice) for which conventional telephone lines are designed. For transmission on these lines, the digital, or pulse, output of a computer or terminal must be converted to an analog signal. Compare with Digital Signal.
ANSI	American National Standards Institute. The coordinating organization for standards in the United States.
ASCII	American Standard Code for Information Interchange. A standard 6-bit (eight bits with parity) character code used for data communications and data processing. A method of coding digital signals using seven or eight bits to generate 96 different characters.
Asynchronous Data	Data accepted or provided in character format, having a start bit, five to eight intelligent bits, possibly a parity bit, and one or two stop bits. Does not require the use of a separate clock.
Attenuation	A reduction or loss of signal strength, measured in decibels. Compare with Gain.
Auto Answer	The ability of a device to respond to an incoming call on a dial-up telephone line and to establish a connection without operator intervention to a remote device.
Auto Dial	The ability of a terminal, node, computer, or similar device to place a call over a switched telephone network and establish a connection without operator intervention.
Auxiliary Channel	A secondary channel that transmits in one direction or the other, independently of the primary channel, under control of secondary channel interface control signals.
Bandwidth	The difference, measured in Hertz (Hz), between the highest and lowest frequencies of a transmission channel.
Baud	(1) The telephone channel audio signaling rate in unit pulses per second. (2) In QAM modulation, a baud is a defined oscillation of an analog wave onto which up to four bits of data can be encoded. Baud also refers to the modem signaling rate in baud per second.
Baud Rate	The rate at which data passes over the telephone line in baud per second.
BER	Bit error rate; the number of bits received in error, per unit time, on a communications link below 9600 bps, in non-TCM modems. Usually expressed as a number referenced to a power of 10, for example, one in 10^4.
Binary	A system of numerical representation that uses only two digits 0 and 1 (in computer usage, Off and On, respectively).

Binary Coded Decimal	A binary numbering system for coding decimal numbers in groups of 4 bits.
Bisynchronous	See BSC.
Bit	(1) The smallest unit in a byte of information. expressed in 1's or 0's. (2) A blend of the two words *bi*nary digi*t*.
Bit Error	An error occurring when the value of an encoded bit is changed in transmission and interpreted incorrectly by the receiver.
Bits Per Second (bps)	The rate at which data passes over the telephone line (that is, the number of information bits in a given time interval). The basic unit of measure for serial data transmission capacity.
BLER	Block error rate; the number of 1000-bit blocks received in error, per unit time, on a communications link above 9600 bps, in TCM-type modems.
Boot	Bootstrap. A technique or program that allows the computer to read or load programs or routines.
bps	See Bits Per Second.
BSC	Binary Synchronous Communications. (1) A procedure that uses control characters and control character sequences for synchronous transmission of binary-coded data between stations in a data communications system. Reference IBM Publication 6A27-3004. (2) Character-oriented data communications protocol.
Buffering	Process of temporarily storing data in a register or in RAM, allowing transmission devices to accommodate differences in data rates and perform error checking and retransmission of data that was received in error.
Byte	The representation (in bits) of a character. A group of bits, usually seven or eight, that represents a unit of information.
Carrier	A continuous frequency that is modulated in any of several means and by which information is transmitted through space or over wire lines from one place to another.
CCITT	Consultative Committee on International Telephone and Telegraph. International data communications standards group.
CCITT V.24	A CCITT Recommendation physical interface, with associated electrical signaling, between data communications equipment (DCE) and data terminal equipment (DTE); the most commonly employed interface used internationally between computers and modems. CCITT V.24 is almost identical to EIA 232-C; however, the electrical signal characteristics are specified separately in CCITT Recommendation V.28.
CCITT V.27 *bis*	4.8 kbps modem with automatic equalizer standardized for use on leased circuits.
CCITT V.29	9.6 kbps modem standardized for use on leased circuits.
CCITT V.33	14.4 kbps modem standardized for use on leased circuits.
Channel	The complete system of equipment and transmission media through which information passes from one geographic location to another. Also used when referring to one of the several lower-speed circuits of a multiplexer, which combines low-speed data signals into a higher-speed transmitted output.
Character	The total number of bits, including start, intelligent, parity, and stop bits, used to define one digit, letter, or symbol, typically asynchronous.

Character-Oriented	Referring to a communications protocol that carries control information encoded in fields of one or more bytes.
Checksum	(1) A system services function used to verify the integrity of a system disk. (2) The sum of a group of data items, which is used for checking purposes.
Circuit	Transmission medium that connects two or more electronic devices.
Circuit Switching	The process of establishing and maintaining a circuit on demand between two or more users. The users have exclusive use of the circuit until the connection is released.
Clock	(1) A timing reference (either internal to the equipment or external) that usually provides a continuous chain of timing pulses (clock pulses). (2) An oscillator-generated signal that provides a timing reference for a transmission link; used to synchronize events such as digital logic or transmission.
Clock Pulse	The output of a device that generates periodic signals used in synchronization; clock signal.
Cluster Controller	A device that controls communications processing for several terminals.
CMEM	(1) A nonvolatile memory used to maintain offline configuration information. CMEM is modified when the configuration is changed via the control terminal port or the operator console. (2) Mainframe memory used to store offline configuration.
Coaxial Cable	A cable consisting of one conductor (usually a small copper tube or wire) surrounded by a shield, normally aluminum tubing or copper braid.
Colocated	Referring to terminals within 50 ft (15.2m) of interface cable per EIA 232-C standard.
Conditioning	Electrically compensating a data line for distortions, typically amplitude and envelope delay for C-conditioning or noise and harmonic distortion for D-conditioning, and also for various grades of minimum requirements that can allow successful data transmission and reception. When a telephone line is conditioned, excess noise is reduced, and the ability of the line to carry a clear data signal is improved. The better the conditioning (for example, C or D), the more expensive the leasing charge for the line.
Contention	An attempt by multiple users to use a transmission channel—whether a PBX circuit, a computer port, or a time slot—within a multiplexed digital facility.
Control Channel	The portion of the communications channel used by the control panel for sending or receiving commands.
Control Panel	The front panel of the modem. Contains all modem control switches, performance indicators, LEDs, and an 8-character alphanumeric display.
CPU	Central processing unit; a computer.
CQMS	Circuit quality monitoring system. A method for monitoring critical parameters of data communications lines and circuits.
Crossover Cable	Special EIA 232-C interface cable allowing normal data transfer between two colocated modems in a tail circuit.
CRT	Cathode ray tube. An electronic device that displays graphic images. Commonly used in data processing.
CTS	Clear To Send.
Cursor	The symbol used on terminals that indicates the position of the next character to be used, inserted, or deleted.

Database	The complete set of data used for decisions, calculations, tabulations, and inferences; systematically organized for access.
Data Communications	The transmission and reception of encoded information over communications lines.
Data Rate	The average number of bits, characters, or blocks per unit of time passing between corresponding equipment in a data transmission system.
DBAAU	Dial backup auto answer unit; an ancillary device for automatic phone answering.
dB	Decibel. A measure of the difference in power between two signals.
dBm	A measure of power in communications: the decibel referenced to one milliwatt (0 dBm = 1 milliwatt).
dB Meter	A meter having a scale calibrated to read directly in decibels at a specified reference level. Usually, 0 dB = 1 milliwatt of power in a 600-ohm load.
DCD	Data carrier detect. This signal is passed from the local modem to the local DTE when an acceptable carrier signal is received by the modem over the phone line.
DCE	Data communications equipment; generally refers to a modem. It converts serial high-speed data from the DTE to audio signals for transmission over the communications channel or converts audio signals from the communications channel to serial high-speed data for the DTE.
DDD	Direct distance dialing (of switched voice-grade circuits that are not equalized for data use). It refers to the public switched, or dial, network.
DDR	Dual dial restoral. An option that provides public switched telephone network backup to the modem's normal leased line channel in the event of failure of that channel.
Dedicated	A dedicated circuit; a nonswitched channel. Reserved or committed to a specific use or application. Synonymous with leased or private, usually referring to communications lines or equipment. See Leased Line.
Default	A predetermined value set by the program if no other value is entered.
Demodulation	Retrieval of an original digital data signal from a modulated analog signal.
Diagnostics	A test program or function that identifies and isolates malfunctions or mistakes.
Dial Up	The process or equipment involved in establishing a temporary connection via the switched telephone network.
Dial-Up Line	A temporary circuit established via the use of the switched telephone network.
Digital Signal	The binary 0 (off) and 1 (on) output of a data terminal. Modems convert digital signals into analog waves for transmission over conventional telephone lines. Compare with Analog Signal.
Distortion	The unwanted change in waveform (signal) that occurs between two points during a transmission; for example, the variation of frequency (frequency response), of time (delay distortion), or of harmonics.
DNP	Distributed Network Processor
DNT	Distributed Network Terminal
Downline	From the central (master) sites to the remote (slave) sites.

Download	The process of transferring network data such as configuration and threshold information from the DNP to the modems, which store it in memory. Also called Downline Program Load.
DSR	Data Set Ready. Indicates the local modem is ready to transmit and receive data.
DTE	Data terminal equipment. (1) A central processing unit (CPU), front-end processor (FEP), high-speed multiplexer, user terminal. (2) Generally, end-user devices that generate or receive data and provide data communications control functions.
DTR	Data Terminal Ready.
Duplex	Simultaneous 2-way transmission and reception. Also known as full-duplex. Requires 4-wire operation.
EBCDIC	Extended Binary Coded Decimal Interchange Code. A set of 256 characters each represented by 8 bits. Used extensively by IBM Corporation.
EIA	Electronic Industries Association. The American electronics standards group.
EIA 232-C	An EIA-specified physical interface, with associated electrical signaling, between data communications equipment (DCE) and data terminal equipment (DTE); the most commonly employed interface between computers and modems.
Embedded Channel	A transmission method where the control channel data is included in extra signal points within the main channel.
Equalization Digital Adaptive	A repeating pattern is transmitted by which the receiver's equalizer can measure and build up compensation factors to correct line distortion. Thereafter, during the data mode, the equalizer continues to make changes to its initial compensation factors as the line characteristics change.
Eye Pattern	An oscilloscope display used to visually determine the quality of an equalized line signal being received.
Exclusion Key Telephone	A telephone with an exclusion key that allows calls to be answered manually and transferred to the modem.
External Clock	Clock signals generated outside the modem.
Fallback	Switching the data system to a lower transmission speed, either for reduced traffic in nighttime operation or because distortion on the telephone lines causes excessive errors at the normal rate.
Fall Forward	Switching the data system from a lower data rate back to the higher, normal, rate.
FCC	Federal Communications Commission.
FDM	Frequency division multiplexing. A system of transmission in which characters or bits belonging to separate messages modulate a series of separate carriers transmitted simultaneously on a single circuit.
FEP	Front-end processor. A dedicated computer that provides data communication functions for a host computer.
FIFO	First in first out; refers to the order in which bits or blocks of bits are processed.
Firmware	Software that is permanently contained in a hardware device, such as a PROM or a ROM.
Format	The structure of data or a message that allows identification of specific control codes or data by their position in the data stream relative to some identifier element.

Four-Wire Circuit	A communication path having two wires for each direction of transmission.
Frequency	The number of times a wave repeats itself in a second; usually expressed in Hertz (Hz).
FSK	Frequency shift keying. A transmission method using two different frequencies that are shifted to represent the digital 0's and 1's.
Full-Duplex Circuit	A signaling circuit that allows simultaneous transmission and reception. Usually 4-wire; can be 2-wire with split band equipment.
Gain	The degree to which a signal's amplitude is increased by passage through an amplifier. Usually measured in decibels.
Gain Hits	A cause of errors in telephone line data transmission, usually when the signal surges more than 3 dB and lasts for more than 4 milliseconds. Bell standards call for 8 or fewer gain hits per 15-minute period.
Half-Duplex	Transmission or reception, but not both simultaneously. Operation controlled by interface control signals. One way at a time, reversible. Usually 2-wire operation, although could be 4-wire.
Handshaking	An exchange of interface signals between a terminal and a modem or between local and remote sites that establishes a communications path and controls the passage of data through the established path.
Harmonic Distortion	Occurs when attenuation of the receive level varies with the amplitude of the signal; for example, a 1V signal may be attenuated by one-half, while a 5V signal may be attenuated by two-thirds. In this way, the signal may be flattened at the peaks, which is equivalent to adding low amplitude harmonics; this distortion is measured according to the relative degree of second and third order harmonics (two and three times the standard frequency, respectively). The result is distorted data transmission.
HDLC	High-level data-link control. (1) The protocol defined by ISO in 1976 for bit-oriented, frame-delimited data communications. (2) CCITT-specified, bit-oriented, data-link control protocol; any related control of data links by a specified series of bits rather than by control characters; the foundation on which most other bit-oriented protocols are based.
Hexadecimal	Base 16 number system. Sixteen characters—ten digits and six letters—condense the long strings of large binary numbers and simplify programming.
Host Computer	An intelligent processor that provides supporting services to users. Generally requires no supervision from other processors.
Hz	Hertz. A measure of frequency. The number of cycles, or complete waves, that pass through a reference point per second; 1 Hz = 1 cycle per second.
Impulse Noise	A type of communications line interference characterized by pulses of high amplitude and short duration.
Impulse Hits	A cause of errors in telephone line data transmission; sharp increase in noise usually caused by electrical disturbance or switching equipment. Voltage surges last from 1/3 to 4 milliseconds that (usually) come to within 6 dB of the normal signal level. Bell standards allow no more than 15 impulse hits per 15-minute period.
Information Rate	Bits per second, characters per second, words per minute, and so forth. Also known as transmission speed.
Initialize	Reset and restart. Similar to boot but generally refers to a hardware activity.

Interface	(1) A shared boundary between two devices in which the electrical signals, connectors, timing, and handshaking are defined; the procedure, codes, and protocols that enable two entities to exchange information. (2) A shared connection or boundary between two devices or systems. The point at which two devices or systems are linked.
Internal Clock	Clock signals generated by the modem.
I/O	Input/output.
ISO	International Standards Organization.
ISO 2110	25-pin DTE/DCE interface connector and pin assignments.
Jitter	An impairment in data communications lines that moves the transmitted data signals forward and backward in time making accurate sampling difficult at the receiver. Other types of jitter can result in a change of the signal's amplitude, frequency, or phase.
Leased Channel	A point-to-point or multipoint data transmission channel reserved (dedicated) for the sole use of a single leasing customer. May be enhanced with line conditioning.
LED	Light-emitting diode. A device that converts electrical signals to light signals.
Line Hit	An increase or decrease in line attenuation or line phase characteristics for less than 300 ms.
Line Loss	A complete loss of carrier signed on the telephone line; a line outage.
Link	One segment of a multibranched communications network.
Local Loop	The telephone line between the user terminal, computer port, or modem and the first telephone office in the line path.
Local Station	A device that is connected to a controlling unit by cables rather than by data links.
Logoff	A procedure by which a user ends a terminal session.
Logon	A procedure by which a user begins a terminal session.
Loop	A single message circuit between a data set and switching center or message distribution point. May consist of 1- or 2-wire pairs; usually 1-wire. Also, the wire connection between a data terminal and a modem, through which a signaling current is passed to provide marking and spacing data signals from the terminal, such as a teleprinter and the modem, that is, a current loop.
Loopback	Any of several methods of feeding a received signal back from some point in the data link to the receiver of the site where the data was originated. Commonly used to test various portions of a data link to isolate faulty equipment or data lines.
LSI	Large scale integration; the inclusion of more than 100 transistors performing various individual but interrelated circuit functions on a single integrated-circuit chip.
Mark	A signaling condition equal to a binary 1.
Mark-Hold	The normal no-traffic signaling condition where a steady marking signal is transmitted and received.
Master Modem	In the multipoint system, the modem that transmits constantly in the outbound direction. Usually the modem at the central site. In a multitier system, the term represents a remote master, or a master modem that is not located at the central site.
MIR	Mixed Inbound Rates. A feature that allows the Codex 2640 and 2650 to operate each slave modem transmitter at a different inbound rate.

Modem	A blend of the words *mo*dulator/*dem*odulator. The term may be used with two different meanings: (1) The modulator and the demodulator of a modem are associated at the same end of a circuit; (2) The modulator and the demodulator of a modem are associated at the opposite ends to form a channel.
Modulation	The process of varying some characteristic of a carrier signal, according to the instantaneous values of samples of the intelligence to be transmitted.
Modulation Rate	Baud per second. The maximum speed of transmitted data over a communications line. Varies as a function of the line capacity, line inductance, insulation quality, bandwidth, and line distortion. Equivalent to the data transmission rate divided by the number of bits per baud.
Monitor	A device that observes and verifies the operations of a data processing system and indicates any significant departure from the norm.
MSQB	Multipoint Signal Quality Binning. A 2600 feature used with Network Management Systems to individually track the performance of the inbound line from each slave modem by providing the percent of polls from each slave with high error probability. Each slave is assigned a bin by Network Management Systems to track its signal quality.
MSU	Modem Sharing Unit. Feature of the multiplexer option that allows the user to share all of the modem's bandwidth or a single Time Division Multiplexer (TDM) channel.
Multiplexer	A device that allows two or more signals to be transmitted simultaneously on a single carrier wave, communications channel, or data channel.
Multipoint	A circuit interconnecting several locations where information transmitted over the circuit is available to all locations simultaneously. The lines on the circuit usually require polling to ensure that only one device transmits at a time.
Mux	Multiplexer.
NCU	Network Control Unit.
Nest	A single enclosure that may contain as many as eight 2600 Series Modems with additional power supplies and fan assemblies plus a Control Panel common to all the modems in the nest.
Network Topology	The physical and logical description of the nodes within a network.
NMU	Network Monitoring Unit.
Node	A point in a communications network where a DNP resides.
Noise	Extraneous and unwanted signal disturbances in a communications link, which tend to degrade the performance of the line.
NTT	Nippon Telegraph and Telephone.
Offline	Equipment or devices not under the direct control of the CPU, or terminal equipment, not connected to a transmission line.
Online	Equipment or devices under the direct control of the CPU, or terminal equipment, connected to a transmission line.
Parallel Transmission	The simultaneous transmission of all bits in a character or of multiple-bit data blocks.

Parity Bit	(1) A noninformation bit added to a group of bits, typically to a 7- or 8-bit byte, that indicates whether the number of 1's in a group of bits is an odd or even number; a basic mechanism for error checking. (2) An error checking mechanism for asynchronous transmission. (3) An additional nondata bit added to a group of bits indicating whether the number of 1's in the group is odd or even.
PBX	Private branch exchange
Phase Hit	A sudden change in phase within the modem carrier recovery loop. According to Bell standards, any time the phase of a 1004 Hz test signal shifts by more than 20 degrees.
Phase Jitter	Any periodic change in the phase of a transmitted signal.
Point-to-Point Line	A line that connects a single remote station to the computer; the line may be either switched or nonswitched.
Polling	1)Interrogation by a central site of a number of remote sites simultaneously, and the response of the remote sites in a particular sequence. 2)Process of asking each device, in sequence and from a central site, if it has a message to send; if so, the polling sequence stops while that device transmits.
Port	A connector, along with any associated circuitry, that enables data to be input to or retrieved from a communications network.
Primary Data Channel	The channel with the higher transmission rate.
Processor	A hardware module (card) containing a microprocessor.
PROM	Programmable read-only memory
Protocol	A formal set of rules governing the format of data and the control of inputs and outputs between two communicating devices, including handshaking and line discipline.
PSTN	Public switched telephone network.
PTT	Postal Telephone and Telegraph System. European governmental-controlled data systems and specifications for communication lines.
QAM	Quadrature amplitude modulation. A method of converting digital to analog data by altering the phase and amplitude of an analog signal to represent digital bits.
Queue	A line or list formed by items in a system waiting for service or processing.
RAM	Random-access memory. Memory with both read and write capabilities.
Receiver Section	The section of the modem that accepts a signal and processes it or converts it for local use.
Remote Station	Any device that is attached to a controlling unit by a long distance data link such as a phone line.
Response Time	The interval between the generation of the last character of a message at a terminal and the receipt of the first character if the reply includes terminal network and service node delays.
ROM	Read-only memory. Memory that can be read from but not written into.
Round Robin Training	A method by which two modems adjust to the current telephone line conditions. One modem sends a training sequence to a second modem, which then answers with a training sequence. Both modems use the received training sequences to make necessary adjustments to line conditions.

RTS	Request To Send. Signal sent from the local terminal to the local modem to ready the modem for data transmission. Part of modem handshaking.
SDLC	Synchronous Data Link Control. Full-duplex; solves the majority of BSC problems although SDLC makes it difficult to troubleshoot the data communications equipment. In SDLC, communication is always between a primary and one of several secondary stations, such as a multipoint system. SDLC systems require a programmable test set that must be able to provide instructions for unusual situations.
Secondary Data Channel	The channel with the lower data rate; often used for Network Management Systems communications or to monitor circuits from a central site.
Serial Port	An I/O port that transmits data one bit at a time. Contrast with parallel port, which transmits multiple (usually eight) bits simultaneously. EIA 232-C is a common serial signaling protocol.
Serial Transmission	The sequential transmission of bits constituting an entity of data over a data circuit.
Signal to Noise Ratio (SNR)	The measurement, in decibels, of signal strength compared to error-causing circuit noise.
Signal Conversion Equipment	Any data communications equipment, for example, a modem, that changes (modulates, filters, shapes, converts, and the like) input data into signals suitable for transmission through the associated communications medium and/or changes received audio line signals into data signals suitable for presentation to the DTE.
Simplex Circuit	A 2-wire signaling circuit for 1-way transmission only.
Space	A signal condition that equals a binary 0.
Space-Hold	An open neutral signaling circuit or a steady spacing signal on a polar signaling circuit. Not a normal condition but occasionally required for test purposes.
Start Bit	A data bit used in asynchronous transmission to signal the beginning of a character.
Statistical Multiplexing	A technique for promoting efficient use of available network link bandwidths. Only terminals requesting service are allocated space in the high-speed frame.
Stop Bit	A data bit used in asynchronous transmission to signal the end of a character.
Sync Character	(1) A character (two or more in bisync) sent from a transmitting station in order to synchronize the clocks of the transmitter and receiver. (2) The character of a defined bit pattern used by the receiving terminal to adjust its clock and achieve synchronization.
Synchronization	The process of adjusting a receiving device clock to match the transmitting device clock.
Synchronous Clocking	A data transmission technique in which the transmitter and receiver operate continuously at the same frequency.
Synchronous Data	Data accepted or provided with an accompanying clock.
Tail Circuit	A point-to-point circuit that connects a remote terminal to a port in a local node. Since the terminal is remote, the connecting communications link requires a modem at each end to ensure error-free data reception. A special crossover cable connects the local modem to the net port.
Tariff	The published rates and procedures for a specific communications service, equipment, or facility, constituting a contract between the user and the communications supplier or carrier.

TCM	Trellis-coded modulation. A form of error-correction coding that interweaves, or trellises, bits of data, allowing receivers to interpret the transmitted data more accurately.
TDM	Time-division multiplexing. The merging, using a multiplexer, of several streams of lower bit rates into a composite signal for transmission over a communications channel of higher bit-rate capacity. For example, five bit streams operating at 100 bps might be accommodated on a channel having a capacity of 500 bps. Combining the data streams is accomplished by assigning a ''time-slice'' of the high-speed channel to each of the low-speed channels.
Terminal	A device, usually equipped with a keyboard and a display, that can send and receive data over a communications channel. Also referred to as data terminal equipment (DTE).
Training	Adjusting modems to current telephone line conditions. The transmitting modem sends a special training sequence to the receiving modem, which makes the necessary adjustments.
Transmission Speed	Bits per second, characters per second, words per minute, and the like. Also known as information rate.
Transmitter	The section of the modem that produces and sends signals.
Turnaround Delay	The time between Request To Send (RTS) and the rise of Clear To Send (CTS).
Turnaround Time	The time required to reverse the direction of transmission when using a 2-way alternate (half-duplex) circuit. This time delay results from line propagation effects, modem timing, and computer reaction delay.
Upline	Transmission from the remote (slave) sites to the central (master) sites.
Virtual Circuit	A communications path established by computerized switching rather than by a physical link. The virtual circuit exists only when it is carrying data.
Voice Grade Channel	A telecommunications circuit used primarily for speech transmission but suitable for the transmission of analog or digital data; supports a frequency range of 300 to 3400 Hz. Also called voice band.
Wideband	48 kHz, typically 40.8 or 50 kbps; 12 voice grade circuits, which equals 1 group.
Zero dBm	Equals 1 milliwatt, with a logarithmic relationship as the values increase.

Index

A

Adaptive Rate System (ARS), 3-2, 3-8B, 3-9
  Line Quality Feature, 2-32A, 2-32B, 3-8A, 3-8B
Analog Line Quality, 2-32A
Assign Category, 2-43, 2-45
Async/Sync Converter, 3-2
Async-to-Sync Conversion, 3-19
Audio Loopback, 3-19, 4-12

B

BER Category, 2-20
BER Test, 1-11, 3-21, 4-12
Bit Error Rate (BER), 1-6
Blind Time, 3-7
Block Error Rate (BLER), 3-8, 3-21, 4-12

C

Cable Connections, 5-10, 5-12
CCITT V.54, 1-11
Channel Rate Parameters, 2-34
Channel Rates, 3-11
Circuit Quality Monitoring System (CQMS), 1-2, 3-8, 3-9, 4-7
Circuit Quality Monitoring System (CQMS) Category, 2-13
Clear Test Category, 2-18
Codex CS48FP Mode, 4-8
Compatibility, 3-8B
  LQ1, 3-8B
  LQ2, 3-8B
  LQ3, 3-8B
Configuration, 2-32A
Configuration Sheets, 2-49, 2-50, 2-52
Configuration Tree, 2-23, 2-25 to 2-32, 2-32B, 2-34 to 2-41
Configuration Tree Category, 2-32B, 2-33
Connect Category, 2-44
Control Panel, 1-2, 1-4, 2-2 to 2-4, 2-7, 2-23, 4-8, 6-3, 6-5
Control Panel Beeper Disable, 1-14
Control Panel Trees, 2-7
Control Signaling, 3-2, 3-17, 3-18, 3-22, 4-10
  Loopbacks, 3-22
  Tests, 3-22
Crossover Cable, 1-9, 5-10, 5-12
Cry For Help (CFH), 4-7, 4-8
CS48FP Mode, 4-8
CS48FP Modem, 4-2
CTS Strap, 3-22

D

Data Pump Card, 1-12, 1-14, 6-5
Data Throughput, 2-32A, 3-8A
DCD Strap, 3-22
DDR Card Replacement, 6-5
Diagnostic Messages, 2-6
Diagnostics, 2-6, 2-13
Diagnostics Category, 2-12
Digital Loopback, 3-19, 4-7, 4-12
DSR Strap, 3-22
DTE Connector, 1-14
DTE Interface, 1-5

E

EIA/CCITT Signals, 3-22, 5-9, 5-10
EIA/CCITT Voltage Levels, 5-8
Embedded Channel, 1-6
Error Messages, 2-7, 2-9
Error Performance, 2-32A, 3-8A
  Criteria, 2-32A
External Timing, 1-9
Eye Pattern Generator (EPG), 1-12, 1-14

F

Fall Forward, 3-9
Fallback, 3-10, 3-11
Fallback Rates, 3-9
Fan Assembly, 6-2
Fan Assembly Replacement, 6-2
Fan Removal, 6-3
Frequency Shift Keying (FSK), 1-5, 1-6
Front Bracket Mounting, 5-4

G

Gearshift Mode, 4-8
General Category, 2-11

H

HSMP Mode, 4-7

I

Installation, 5-3 to 5-6, 5-8 to 5-10, 5-12
Installation Flowcharts, 5-13, 5-14, 5-16, 5-17

L

Leasing, 7-2
Line Quality Feature, 2-32A, 2-32B, 3-8A, 3-8B
  Error Performance, 2-32A, 3-8A
  Throughput Delay, 2-32A, 3-8A
Logout, 2-7
Loopback Category, 2-17
Loopback Timing, 1-8, 4-7
Loopbacks, 3-19, 3-22, 4-10, 4-12, 4-15
  Multipoint Loopbacks, 4-10
Loopbacks and Tests, 1-11
LQ1, 2-32A, 3-8A, 3-8B
LQ2, 2-32A, 3-8A, 3-8B
LQ3, 2-32A, 3-8A, 3-8B

M

Maintenance, 6-1, 6-2, 6-3, 6-5
Message Tree, 2-48
Miscellaneous Category, 2-47
Mixed Inbound Rates (MIR), 4-2, 4-7, 4-8
Modem Category, 2-25 to 2-30, 4-8
Modem Check, 3-19, 4-12
Modem Sharing Unit (MSU), 3-2, 3-10, 3-11, 4-6, 4-10
Modem Strap 01 Category, 2-31
Modem Strap 02, 3-9
Modem Strap 02 Category, 2-32
Modem Timing, 1-8
  Crossover Cable, 1-9
  External Timing, 1-9
  Internal Timing, 1-8
  Loopback Timing, 1-8
Monitoring Line Quality, 2-32B
MP Mode, 4-7, 4-8
Multiplexer, 3-2, 3-10, 3-11, 5-10
Multipoint Applications, 4-6 to 4-8, 4-10, 4-12, 4-14
Multipoint Loopbacks, 4-10, 4-12
Multipoint Mode, 4-2 to 4-5
Multipoint Modes, 1-3, 4-7
Multipoint Signal Quality Binning (MSQB), 4-2, 4-7, 4-8
Multipoint Tests, 4-14
Mux 1 and Mux 2 Categories, 2-32A to 2-34
Mux Configurations, 3-14, 3-16

N

Network Control Category, 2-39, 2-40
Network Control Channel, 1-5
Network Control Strap 21, 2-41
Network Management Systems, 1-3 to 1-6, 4-7, 4-8
Network Management Systems Applications, 1-4
Network Management Systems Interface Cable, 5-8
Numerical Data Entry, 2-7

O

Operating Mode, 3-10
Operating Modes, 1-3, 2-26, 2-27, 3-5, 3-8, 3-10, 4-4, 4-5, 4-7, 4-8

P

Packaging Guidelines, 7-3
Password Protection, 2-7
PC Cards, 6-5
  Removal, 6-5
  Replacement, 6-5
Point-to-Point Applications, 3-5 to 3-11, 3-14, 3-16 to 3-19, 3-21
Point-to-Point Codex-Improved Mode (PP CI), 3-10
Point-to-Point Loopbacks, 3-19
Point-to-Point Mode, 3-2, 3-4 to 3-6
Point-to-Point Modes, 1-3, 3-10
Poll Category, 2-19
Poll Test, 1-11, 3-21, 4-12
Port n Category, 2-35 to 2-38
Port Select Category, 2-15
Port Timing, 1-9
  Asynchronous Data, 1-10
  Isochronous Data, 1-10
  Synchronous/External Timing, 1-9
  Synchronous/Internal Timing, 1-9
  Synchronous/Station Timing, 1-10
Port-to-Channel Mapping, 4-10
Power Cord, 5-6
Power Fail Tone, 1-5, 1-14

Power Supply Replacement, 6-2
Power-Up, 1-6, 2-6, 2-7
Product Codes, 1-16, 1-17
Product Configurations, 3-6, 4-5
Product Features, 1-2, 3-4, 4-3
Protocols, 2-32A
  Full Duplex, 3-8A

R

Rack-Mount, 5-3
Rear Bracket Mounting, 5-4, 5-5
Rear Panel, 2-5
Rear Panel I/O Card, 5-6, 5-10
Remote Address, 2-43
Remote Operations, 2-43
Remote Tree, 2-7, 2-42 to 2-48
Repackaging Guidelines, 7-2
Repair/Replacement, 6-2
Repairs, 7-2
Return Procedures, 7-1 to 7-6
Ribbon Cable Connection, 6-5
Round Robin (RR), 1-3, 3-5 to 3-10
RTS Strap, 3-22

S

Search Category, 2-43, 2-46
Self Category, 2-21
Self Test, 1-6, 1-11, 3-21, 4-14
Serial Number, 2-43
Service Replacement, 7-2
Signal-to-Noise Ratio, 1-6, 3-10
Site Selection and Preparation, 5-3
Specifications, 1-15
Status Tree, 2-10 to 2-13, 2-15
Status Display, 3-8B
  Line Quality, 3-8B
Synchronization, 3-8B

T

Tail Circuit, 1-10, 5-10
Terminal Loopback, 3-19
Terminal Looppback, 4-10
Test Tone, 1-11, 3-21
Test Tree, 1-11, 2-16 to 2-22
Test Tree Results (XXX Results Category), 2-22
Throughput Delay, 3-8A
Time Division Multiplexer (TDM), 3-10, 3-11
Time Division Multiplexing (TDM), 4-10
Timeout, 2-7
Timing, 1-6 to 1-10
Train On Data (TOD), 3-10, 4-2, 4-7, 4-8, 4-10
Transmit Level, 1-3, 3-5
Transmit Levels, 2-31
Trellis-Coded Modulation (TCM), 3-2, 3-5, 3-8, 3-8A
Troubleshooting Flowcharts, 5-13, 5-19, 5-21, 5-22, 5-24 to 5-29, 5-31
Troubleshooting Indicators, 5-19

U

Unattended Initiate (UI), 1-3, 3-5, 3-6, 3-9
Unpacking/Repacking, 5-1, 5-2

V

V.27, 3-10
V.27 *bis,* 4-2, 4-10
V.29, 3-10, 3-11
V.33, 3-10
V.33 Mode, 3-10, 3-11, 3-17
Voltage Check, 5-19, 5-28, 5-29, 5-31

2600 Series Modem
User's Manual
Part No. 07588, Rev E
December 1986

USER QUESTIONNAIRE

Thank you for taking the time to complete this survey. Codex products serve customers who have a wide range of data communications experience. We want our documentation to match our customers' experience and needs. Your responses to this survey will help us meet this goal. Using a scale of 1 to 5, with 5 representing the highest (most favorable) rating, please circle the number that reflects your response. Leave blank if question is not applicable to your manual.

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How helpful are the troubleshooting procedures?		1	2	3	4	5	
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What do you suggest to improve this document? ______________________________

____

____

What features or techniques that you've seen in other manuals would you like to see in ours? __________

____

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What types of information would you like to see included or expanded upon? ______________

____

____

Other? ____

____

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Product Options

ABOUT THIS SECTION

A number of product options are available with 2600 Series Modems, including multiplexers, special test procedures, dial back-up protection, and the expanded XL features. These options are briefly described below with the appropriate product codes. Separate product user guides that accompany any of the product options you purchase give in-depth explanations of operations and applications. These guides can be inserted into this section of your binder.

MULTIPLEXER

The 2680, 2685, 2660, and 2666 can be equipped with an integral 4- or 6-channel buffered multiplexer that permits multiplexing two, three, four, five, or six channels at a wide variety of transmission rates. A 4-channel multiplexer option only is available in the 2640 and 2645 models. Channel speed allocation is accompanied by selecting (via the local Control Panel or the Network Management Systems central site) one of the many preconfigured or user-configurable mux modes. In addition, the multiplexer options on the 2660 and 2665 include a built-in Modem Sharing Unit (MSU), which can be configured to share all or part of the modem bandwidth on a single multiplexed channel.

DUAL DIAL RESTORAL

The Dual Dial Restoral (DDR) and Enhanced DDR options provide PSTN (Public Switched Telephone Network) backup to the normal leased line channel of the modem in the event of failure of that channel. This backup comes via two PSTN channels so that full-duplex operation can be restored. Both primary (main) and secondary (control) data channels are reinstated.

Since the performance of PSTN channels is not controlled as closely as that of leased lines, limitations and variations in these channels may require a reduction in the normal transmission rate. The modem will not automatically change modes when going between the leased and dial lines. Any mode changes necessitated by the potential deterioration of line conditions in the switched network must be effected through manual reconfiguration or implementation of the Adaptive Rate System (ARS) for the 2660 and 2680. Manual reconfiguration may be performed through Network Management Systems, the local Control Panel, or the remote Control Panel.

The restoral is full-duplex, requiring two PSTN lines. Upon command, the central site modem establishes a connection with the remote site modem by dialing two sets of stored telephone numbers. When a ring is detected, the remote modem will automatically answer each call and return an Answer Back Tone (ABT) in acknowledgment. If both calls are answered within a defined time period, the calls are assumed to be valid and both modems switch transmission to the PSTN lines. Once the leased line failure is corrected, you can command both modems to discontinue the restoral operation and to return transmission to the leased line.

Both programmable and permissive transmit level connections are available with the DDR and Enhanced DDR options.

COMMUNICATIONS TEST EQUIPMENT

Communications Test Equipment (CTE) is an option designed for 2600 Series Modems that operate as part of the Codex Network Management Systems. The CTE option contains two features—the Remote Data Scope (RDS) and the Transmission Impairment Measurement System (TIMS)—which provide an accurate method of measuring communication line problems while eliminating the need for expensive, external test equipment. The TIMS test is standardized in accordance with the Bell System Technical Reference No. 41009 and IEEE 743-1984.

The RDS feature of CTE is a qualitative diagnostic tool that assists in identifying communication line problems without interrupting normal operation. RDS isolates and traps main channel data at any single DTE port, and relays a snapshot of that data to Network Management Systems central site for display on the network console. RDS is also useful in confirming the quality of a link before initiating further testing. This feature monitors synchronous lines with byte- (BSC) and bit- (HDLC) oriented protocols as well as asynchronous lines.

TIMS measures critical telephone line characteristics by performing an analog ''line sweep'' on the circuit between two 2600 Series Modems. The results of this test are then compared to the tariffed telephone line parameters to determine if the line is functioning within specifications. The TIMS option performs the following quantitative tests: Receive Level, Signal-to-Noise Ratio, Phase Jitter, Harmonic Distortion, Amplitude Distortion, and Envelope Delay Distortion.

Manual calibration of the specific modem transmitter and receiver is required to meet the stated accuracy of the TIMS test. A modem that contains a factory-installed CTE option will arrive fully calibrated; otherwise, calibration must be performed at the time the CTE option is installed in your modem as a separate item or when you replace the Data Pump or DTE card. Once the CTE option is installed in your 2600 Modem, the TIMS✳ Category is automatically added to the Configuration Tree.

2608 8-MODEM NEST

The 2608 8-Modem nest consists of a single enclosure that may contain as many as eight 2600 Series Modems, four power supplies (one for every two modems), a fan assembly with three removable fans, and a Control Panel that is common to all modems in the nest.

The 2608 allows you to mix and match 2620, 2640, and 2660 Modems with 4- or 6-channel multiplexer options in both point-to-point and multipoint applications. Both the 4- and 6-channel options include the built-in Modem Sharing Unit (MSU), async/sync converter, and control signaling capability.

Once you have installed a minimum of one modem and one power supply, you can add additional modem card sets and power supplies. These components can then be configured from the 2608 Control Panel or from Network Management Systems central site. With the exception of the XL and DDR options, all of the 2600 Series features and operating modes are available for each modem in the 2608 8-Modem nest including Trellis Coded Modulation (TCM), Adaptive Rate System (ARS), Mixed Inbound Rate (MIR), Codex Improved 96 (CI 96), and Train On Data (TOD). A new category, NEST✳, has been added to the Remote Tree, which allows you to transfer the Control Panel Connection to any modem in the 2608 8-Modem nest.

PRODUCT OPTION CODES

Domestic

31004	4-channel mux upgrade kit
31006	6-channel mux upgrade kit
31020	Integrated Dual Dial Restoral unit
31061	Communications Test Equipment
31054	Communications Test Equipment with Integrated Dual Dial Restoral unit
32600	2608 8-Modem nest

International

31014	4-channel mux upgrade kit
31016	6-channel mux upgrade kit

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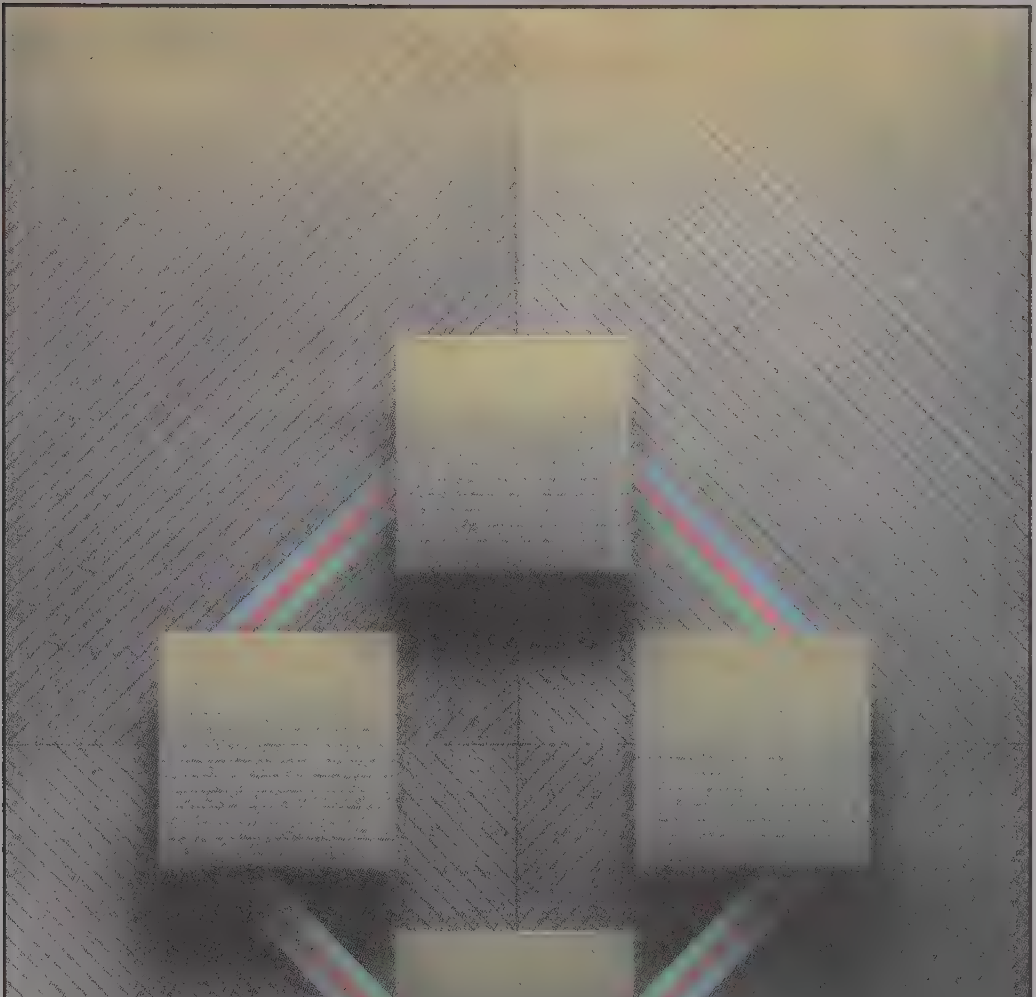

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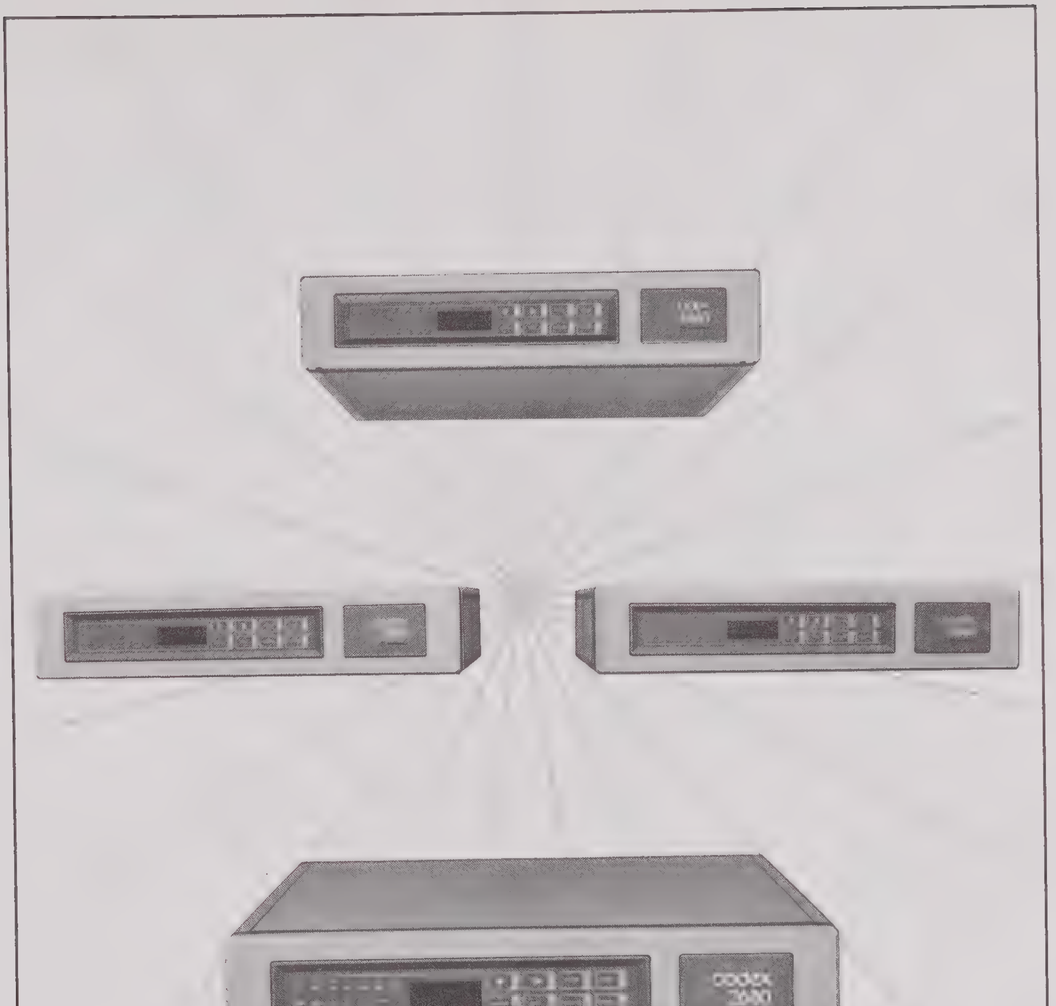

2600 Series DDR User's Guide

Notice

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User/Reader Comments

A prepaid user questionnaire form is provided in the back of this manual for your comments. Codex welcomes your comments; your input is important in helping us improve the effectiveness of this manual. Thank you.

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

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Editor: Lisa A. Maregni

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Contents

Chapter 1. Introduction

How to Use this Document 1-1
Description 1-1
Parts List 1-2
Differences in Control Panel Operation with the DDR Option 1-2
Site Requirements 1-2
  Exclusion-Key Telephone Sets 1-2
  Direct Connection with No Line Control 1-3
  Jacks 1-3
Product Options 1-3

Chapter 2. DDR Option and the Control Panel

DDR Category Overview 2-1
Status 2-3
Initialize 2-3
  Auto Call without Telephones 2-3
  Auto Call with Exclusion-Key Telephones 2-5
  Manual Originate 2-5
Terminate 2-6
  Dial-Line Termination from the Control Panel 2-6
  Dial-Line Termination from an Exclusion-Key Telephone 2-7
Modem Strap 22 2-8
Remote Address 2-10
  Remote Receive and Transmit (1 to 4) 2-10
  Entering a Telephone Number 2-10
  Pauses in Dialing 2-10

Contents (continued)

Chapter 3. Enhanced Dual Dial Restoral (Enhanced DDR)

General 3-1
  Modem Strap 22 3-3
  Modem Strap 23 3-4

Chapter 4. Installation Procedures

FCC Requirements 4-1
  Type of Service 4-2
  Telephone Company Procedures 4-2
  Disconnection 4-2
I/O Assembly 4-2
Direct Connection with Permissive Jacks 4-5
FCC Label 4-6
Printed Circuit Card 4-6
Cable Installation 4-6

Chapter 1
Introduction

Contents

How to Use this Document 1-1
Description 1-1
Parts List 1-2
Differences in Control Panel Operation with the DDR Option 1-2
Site Requirements 1-2
  Exclusion-Key Telephone Sets 1-2
  Direct Connection with No Line Control 1-3
  Jacks 1-3
Product Options 1-3

HOW TO USE THIS DOCUMENT

The Dual Dial Restoral (DDR) Option is a feature of the 2600 Series modems. It is assumed that you have already read the Codex *2600 Series Modem User's Manual* and that you are familiar with the product, data communications explanations, and operating and troubleshooting explanations. Chapters 1, 2, and 4 describe the 2600 DDR Option, its installation, its operating instructions, and any features that may affect the normal operation of the 2600 Series Modem. Chapter 3 provides a detailed description of the Enhanced DDR option which can be ordered for completely automatic dial-backup applications.

DESCRIPTION

The FCC-approved Dual Dial Restoral (DDR) Option provides Public Switched Telephone Network (PSTN) backup for the modem's normal leased-line channel if that channel fails. This backup is effected via two PSTN lines, which restore full-duplex service for both primary (main) and control data channels. Complete configuration and control of the DDR Option is accomplished either through the 2600

Control Panel or the Network Management Systems central site. Since PSTN channel performance is not controlled as closely as leased-line performance, limitations and variations in these channels may require reducing the normal data rate. When the 2680 and 2660 models are operating in the Adaptive Rate System (ARS) mode, this rate adjustment is performed automatically. In all other cases, the operating mode and rate selections are accomplished in the usual fashion — that is, by stepping through the Configuration Tree and entering the desired selection (see Chapter 4 of the *2600 Series Modem User's Manual* for a detailed explanation of the tree).

The full-duplex restoral requires two PSTN lines. Upon command, the central site modem establishes a connection with the remote site modem by automatically dialing two previously stored telephone numbers, selecting pulse or tone dialing as appropriate (except when Blind Dial is enabled, in which case pulse or tone is strap selectable). When the remote site modem detects ringing, it answers the call and returns an Answer Back Tone (ABT) in acknowledgment. If both calls are answered within a defined time and the calls are considered valid, both modems switch transmission to the PSTN lines. While operating over the PSTN lines, the operator can periodically test the leased-line quality and switch back when performance is acceptable.

PARTS LIST

The DDR Option for the 2600 Series Modem consists of a printed circuit board and associated hardware. When the DDR Option is ordered with the modem, it is installed at the factory; you simply install the audio cables. When the DDR Option is ordered separately, some installation is required. Before installing the option, as explained in Chapter 4, ensure that you have the following parts:

- Printed circuit board in antistatic bag
- I/O assembly with two modular jacks
- Accessory kit containing:

  Two mounting screws

  14-ft (4.26m) transmit cable (modular plug to modular plug)

  14-ft (4.26m) receive cable (modular plug to modular plug)

  FCC Part 68 registration label

DIFFERENCES IN CONTROL PANEL OPERATION WITH THE DDR OPTION

When the Dual Dial Restoral Option is in operation, you will observe the following changes:

- The fallback (FLBK) LED is illuminated. If your system control channel runs at 110 bps and you experience degraded Network Management Systems performance over the dial lines, changing the control channel rate to 75 bps should resolve any Network Management Systems performance problems.
- The Self Test is not valid while operating over dial lines.

Other than these changes, the features, Control Panel commands, tests, etc., function in an identical manner to the 2600 Series under normal operation.

SITE REQUIREMENTS

The DDR Option requires two telephone lines with associated jacks. The option can operate either with or without telephone sets; however, if telephone sets are used, they must have exclusion keys.

Exclusion-Key Telephone Sets

The exclusion-key telephone allows calls to be answered manually and transferred to the modem using the exclusion key. To use an exclusion-key telephone, you must have an RJ36X interface with each RJ45S (or RJ41S) data set interface and either a type 502 (rotary dial) or a type 2502 (tone dial) telephone. The exclusion-key telephone may be wired for "telephone set control of the line" or "data set control of the line," as explained below. If you are planning to use a telephone set, we recommend that you use it with "data set control of the line."

Data Set Control of the Line. Data set control is normally used with Auto Call and Auto Answer, because data is passed and calls are answered and/or terminated with the telephone handset on-hook. For voice communication over the line, the telephone must be off-hook and the exclusion key must be up.

Telephone Set Control of the Line. This selection is normally used with Manual Answer or Manual Originate; however, it may also be used with a modem in the Auto Call and Auto Answer modes. The telephone must be off-hook, with the exclusion key up, for the modem to be connected to the line. For voice communication, the telephone must be off-hook and the exclusion key must be down.

Direct Connection with No Line Control

Direct Connection with no line control is used when the modem is configured for Auto Answer or Auto Call without telephone handsets. The 2600 Series modems can operate in either programmable or permissive mode (see Chapter 4 for information on setting straps in either mode).

For a programmable transmit level in direct connection without the exclusion key, use an RJ45S jack, which ensures that the transmitted signal arrives at the central telephone company office with an optimum signal power of − 12 dBm.

For a permissive transmit level in direct connection you should use an RJ11C jack, which permits a fixed level of − 9 dBm for the transmitted signal to the central office.

Jacks

The type of telephone jack required depends on your needs. Table 1-1 will help you identify the jacks that match your installation requirements. See Chapter 4 for information on installing jacks.

PRODUCT OPTIONS

The following options are available for Dual Dial Restoral.

Product Code	*Option*
31020	Integrated Dual Dial Restoral Unit, Programmable
31021	Integrated Dual Dial Restoral Unit, Permissive
31010	Enhanced Dual Dial Restoral Unit, Programmable
31011	Enhanced Dual Dial Restoral Unit, Permissive

Table 1-1.
DDR Jack Requirements

Application	*Jack*
Telephone handset not used (e.g., Auto Call or Auto Answer) Direct connection to PSTN with programmable transmit level	RJ45S
Telephone handset used (e.g., Manual Originate/Answer) Direct connection to PSTN with programmable transmit level when under control of exclusion-key telephone	RJ45S/RJ36X Combination*
Telephone handset not used (e.g., Auto Call or Auto Answer) Direct connection to PSTN with permissive transmit level	RJ11C

* The modem cable always plugs into the RJ45S data jack; the exclusion-key telephone plugs into the RJ36X voice jack.

Chapter 2
DDR Option and the Control Panel

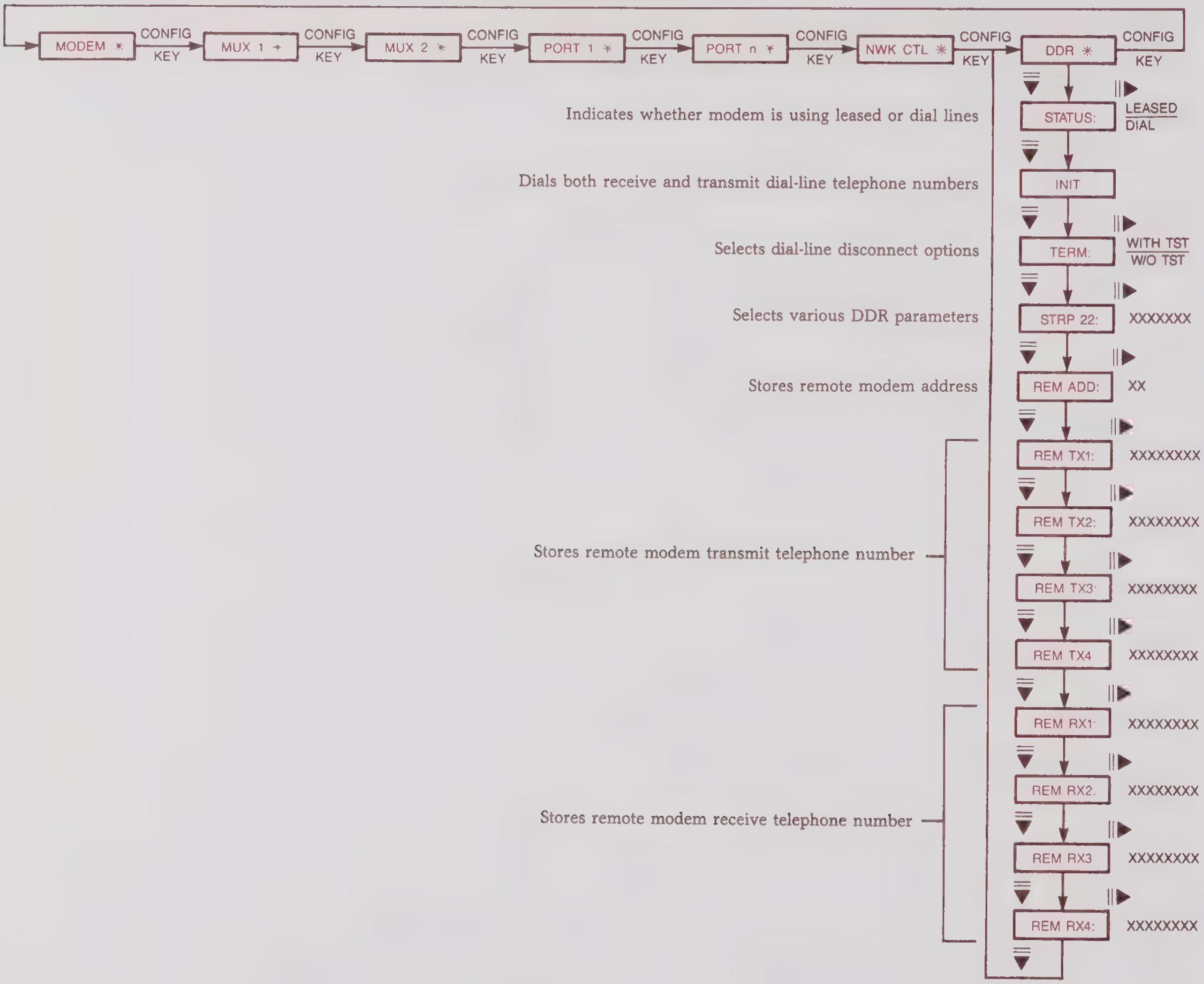
Contents

DDR Category Overview 2-1
Status 2-3
Initialize 2-3
  Auto Call without Telephones 2-3
  Auto Call with Exclusion-Key Telephones 2-5
  Manual Originate 2-5
Terminate 2-6
  Dial-Line Termination from the Control Panel 2-6
  Dial-Line Termination from an Exclusion-Key Telephone 2-7
Modem Strap 22 2-8
Remote Address 2-10
  Remote Receive and Transmit (1 to 4) 2-10
  Entering a Telephone Number 2-10
  Pauses in Dialing 2-10

DDR CATEGORY OVERVIEW

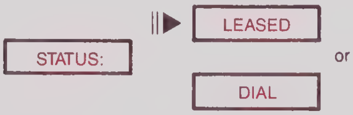
A number of DDR functions can be selected from the Control Panel by moving through the DDR category of the Configuration Tree (DDR*). (See the Configuration Tree section in Chapter 4 of the *2600 Series Modem User's Manual* for explanations of the remaining Configuration Tree categories.) This category is automatically added to the Configuration Tree when the DDR Option is installed into a 2600 Series modem.

DDR✳ CATEGORY OF THE 2600 SERIES MODEM CONFIGURATION TREE


MODEM ✳
CONFIG KEY
MUX 1 ✳
CONFIG KEY
MUX 2 ✳
CONFIG KEY
PORT 1 ✳
CONFIG KEY
PORT n ✳
CONFIG KEY
NWK CTL ✳
CONFIG KEY
DDR ✳
CONFIG KEY
Indicates whether modem is using leased or dial lines
STATUS:
LEASED
DIAL
Dials both receive and transmit dial-line telephone numbers
INIT
Selects dial-line disconnect options
TERM:
WITH TST
W/O TST
Selects various DDR parameters
STRP 22:
XXXXXXX
Stores remote modem address
REM ADD:
XX
Stores remote modem transmit telephone number
REM TX1:
XXXXXXXX
REM TX2:
XXXXXXXX
REM TX3:
XXXXXXXX
REM TX4
XXXXXXXX
Stores remote modem receive telephone number
REM RX1:
XXXXXXXX
REM RX2.
XXXXXXXX
REM RX3
XXXXXXXX
REM RX4:
XXXXXXXX

STATUS

The Status (STATUS:) subcategory indicates whether the modem is using leased or dial lines. If a leased line is in use, LEASED is displayed; if dial lines are in use, DIAL is displayed.



INITIALIZE

Use the Initialize function (INIT) to switch from leased lines to dial lines. If you try to initialize the dial function while already operating on dial lines, ERROR 50 is displayed.

Message	*Definition*	*Action*
ERROR 50	Already on dial line.	No action is necessary.

Auto Call Without Telephones

Entering the Initialize function causes the modem to dial both the receive and transmit telephone numbers. If you reenter the Initialize function while the modem is dialing, the dialing sequence will be terminated, and ABORTED will be displayed. ■ **Note:** See the section titled Modem Strap 23 in Chapter 3 for procedures if you enter the Initialize function while DTR is down.

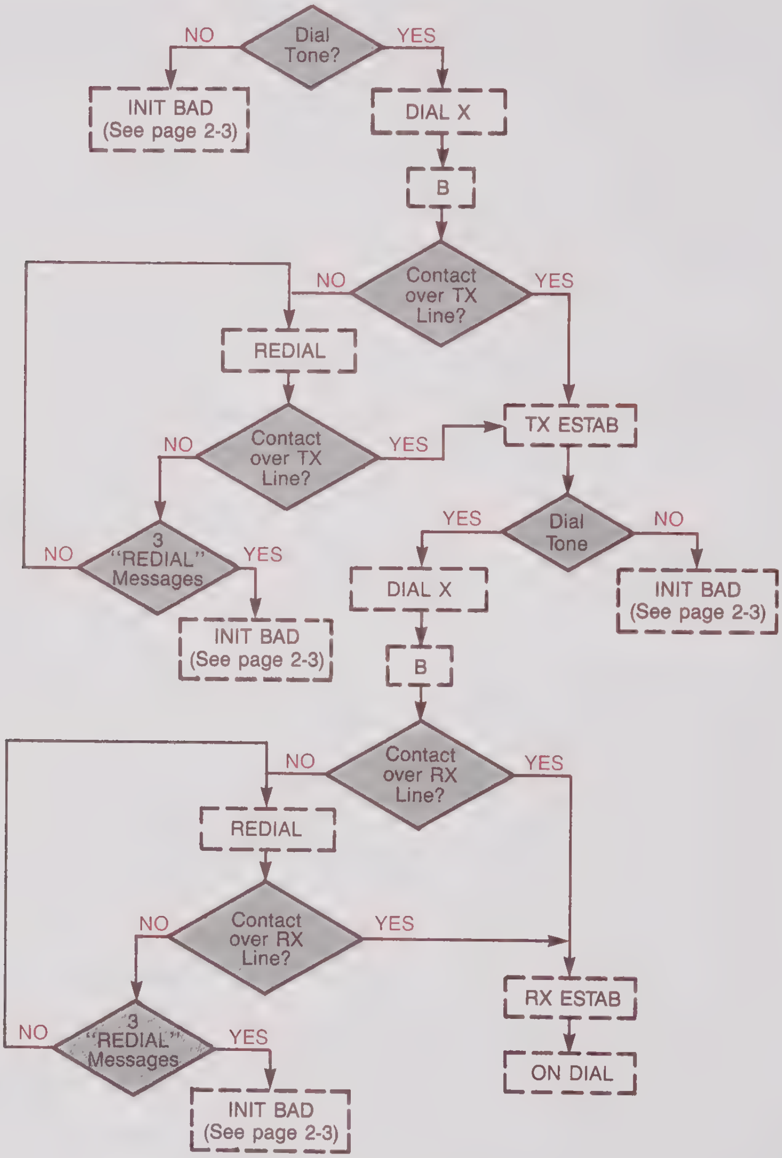
After you enter the Initialize function, the modem first checks for a dial tone, automatically selecting pulse or tone dialing. Note that if Blind Dial has been selected, pulse or tone dialing is strap selectable (see the section entitled Modem Strap 22 later in this chapter). If the modem senses a dial tone, it dials the transmit line telephone number of the remote modem, concurrently displaying DIAL X, where X represents the telephone number digits. When finished, it will display the letter B (the terminator). If the modem doesn't sense a dial tone, or if it senses a nonstandard dial tone, INIT BAD is displayed. In the case of a nonstandard dial tone, enable the Blind Dial strap (see the section titled Modem Strap 22 later in this chapter).

If contact is established over the transmit line for the remote modem, TX ESTAB is displayed. If contact is not established, the modem redials while displaying REDIAL. If the redial is unsuccessful, the modem displays REDIAL again while trying a third time. After a third unsuccessful attempt, INIT BAD is displayed. An INIT BAD message displayed after dialing may be caused by one of the following conditions:

- Reversed transmit and receive telephone numbers.
- Incorrect telephone number.
- Busy signal. In rare cases, after terminating dial connections using the Terminate Without Test (TERM: W/O TST) selection, the remote modem remains connected to a dial line, causing a busy signal. To solve this problem, power off and then power on the remote site modem.
- Dial line not connected to remote modem.
- Auto Answer strap disabled on remote modem.
- Remote site telephone line inoperative.

Once TX ESTAB is displayed, the modem follows the above sequence again, this time dialing the receive line telephone number for the remote modem while displaying DIAL X. If contact is established over the receive line for the remote modem, RX ESTAB is displayed. If contact is not established, the modem redials, and if two subsequent redialing attempts fail, it displays INIT BAD.

Once both telephone connections are established, the modem switches to dial-line operation and displays ON DIAL. This process is illustrated in Figure 2-1.


Dial Tone?
NO
YES
INIT BAD (See page 2-3)
DIAL X
B
Contact over TX Line?
NO
YES
REDIAL
Contact over TX Line?
NO
YES
TX ESTAB
3 "REDIAL" Messages
NO
YES
INIT BAD (See page 2-3)
Dial Tone
YES
NO
DIAL X
INIT BAD (See page 2-3)
B
Contact over RX Line?
NO
YES
REDIAL
Contact over RX Line?
NO
YES
3 "REDIAL" Messages
NO
YES
INIT BAD (See page 2-3)
RX ESTAB
ON DIAL

■**Note:** Items with broken lines contain displayed messages.

Figure 2-1. Initialize Function

Auto Call with Exclusion-Key Telephones

Note that the following actions must be performed on both telephone sets.

Data Set Control of the Line. With the handset on the hook, this type of exclusion-key telephone is invisible to the modem, and the Initialize function operates normally.

Telephone Set Control of the Line. For the modem to automatically dial when linked to this type of exclusion-key phone, you must first pull up the exclusion key and leave the phone off the hook. Then enter the Terminate Without Test (TERM: W/O TST) function. After this is done, the Initialize function operates normally.

Manual Originate

When you are using Manual Originate, the second telephone connection must be made within three minutes of the first connection, or the first connection will be dropped. ■ **Note:** See the section titled Modem Strap 23 in Chapter 3 for procedures if you use Manual Originate while DTR is down.

Data Set Control of the Line. To manually dial from this type of exclusion-key phone, bypass the Initialize function on the Control Panel and follow the Manual Originate procedure outlined below.

1) If you are manually dialing a call that will be *manually* answered, disable Auto Answer on Strap 22 of the remote modem. If you are manually dialing a call that will be *automatically* answered, enable Auto Answer on Strap 22 of the remote modem.

2) Dial the transmit number of the remote modem from the receive telephone of the local modem.

3) When the call is answered by the remote operator, or when you hear an Answer Back Tone (ABT), hang up the handset.

4) Dial the receive number of the remote modem from the transmit telephone of the local modem.

5) When the call is answered by the remote operator, or when you hear an ABT, hang up the handset.

Telephone Set Control of the Line. To manually dial from an exclusion-key telephone with telephone set control of the line, bypass the Initialize function on the Control Panel and follow the Manual Originate procedure outlined below.

1) If you are manually dialing a call that will be *manually* answered, disable Auto Answer on Strap 22 of the remote modem. If you are manually dialing a call that will be *automatically* answered, enable Auto Answer on Strap 22.

2) Dial the transmit number of the remote modem from the receiving phone of the local modem.

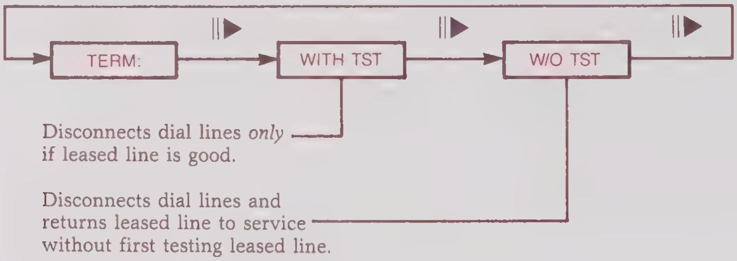
3) When the call is answered by the remote operator, or when you hear an ABT, pull up the exclusion key and leave the handset off the hook.

4) Dial the receive number of the remote modem from the transmit phone of the local modem.

5) When the call is answered by the remote operator or you hear an ABT, pull up the exclusion key and leave the handset off the hook.

TERMINATE

Using the Terminate (TERM:) function, you can disconnect the dial lines either with or without first testing to see if the leased line is capable of accurate data transmission.



Disconnects dial lines *only* if leased line is good.

Disconnects dial lines and returns leased line to service without first testing leased line.

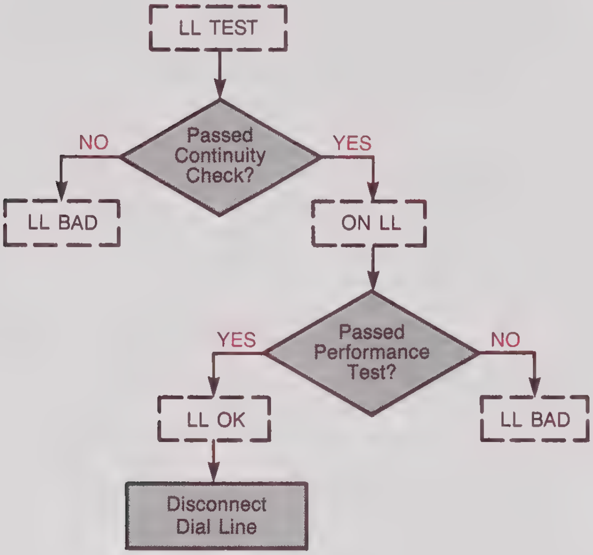
Dial-Line Termination from the Control Panel

If you are already operating on a leased line and you try to terminate dial operation, ERROR 52 is displayed.

Message	*Definition*	*Action*
ERROR 52	Already on leased line.	No action is necessary.

Terminate with Test (TERM: WITH TST). After this option is entered, a "get ready for leased line test" command is sent to the remote modem over the dial lines. If there is no response, or if an invalid response is received over the dial line, ERROR 20, 30, or 40 is displayed, and the modems remain on the dial lines. ■ **Note:** When Terminate with Test is selected, main channel data is temporarily disrupted while the modems switch and train between dial and leased line main channel operation.

Message	*Definition*	*Action*
ERROR 20	No response received from remote modem.	Verify the remote Network Control address. Try again after a 3-minute wait. If the same error occurs, terminate using "W/O TST" selection.
ERROR 30	Invalid response was received from remote modem.	Try again after a 3-minute wait. If the same error occurs, terminate using "W/O TST" selection.
ERROR 40	Remote modem is in Override.	Take the remote modem out of Override. See the Miscellaneous category (MISC✳) paragraph in Chapter 4 of the *2600 Series Modem User's Manual* and try again.



■**Note:** Items with broken lines contain displayed messages.

Figure 2-2. Terminate with Test

If the initial commands got through over the dial lines, the leased lines are now checked for continuity, using a control channel command. At this point, LL TEST is displayed. If the continuity check passes, the main channel is switched from dial to leased service, and the leased line is tested for performance. ON LL is displayed. The performance criteria for the leased-line test are determined by the setting of the Unattended Initiate (UI) error-rate threshold bit in Strap 02 of the local and remote modems. The UI setting corresponds to a BER of 10^{-3} or 10^{-4} (see the MODEM✳ category paragraph in Chapter 4 of the *2600 Series Modem User's Manual*). If the leased line passes the performance test, the modem displays LL OK and disconnects the dial lines; if the line fails the test, LL BAD is displayed, and the dial lines are automatically placed back in service (see Figure 2-2).

If leased-line quality deteriorates while it is being tested, one of the following error messages may be displayed:

Message	*Definition*	*Action*
ERROR 54	Remote modem is not responding.	Wait maximum of three minutes for remote modem to switch back to dial lines.
ERROR 56	Remote modem is not responding.	Check to see if modem is passing data on dial line. If not, terminate using the "W/O TST" selection.

Terminate without Test. If you have made dial-line contact between modems but you want to redial because the quality of the connection is unacceptable, first use the Terminate Without Test (TERM: W/O TST) function.

If you simply want to terminate dial-line service and return to a leased line, it may take up to one minute before data can be transferred, assuming that the leased line is good.

The Terminate Without Test selection first attempts to disconnect the remote dial connection by sending a command over the control channel. Even if the command doesn't get through, it disconnects the local dial connections. The remote modem should subsequently drop its dial connection. See Strap (f) in the section titled Modem Strap 22 in Chapter 3 for a further explanation.

Dial-Line Termination from an Exclusion-Key Telephone

There are two ways to execute a dial-line termination from an exclusion-key telephone:

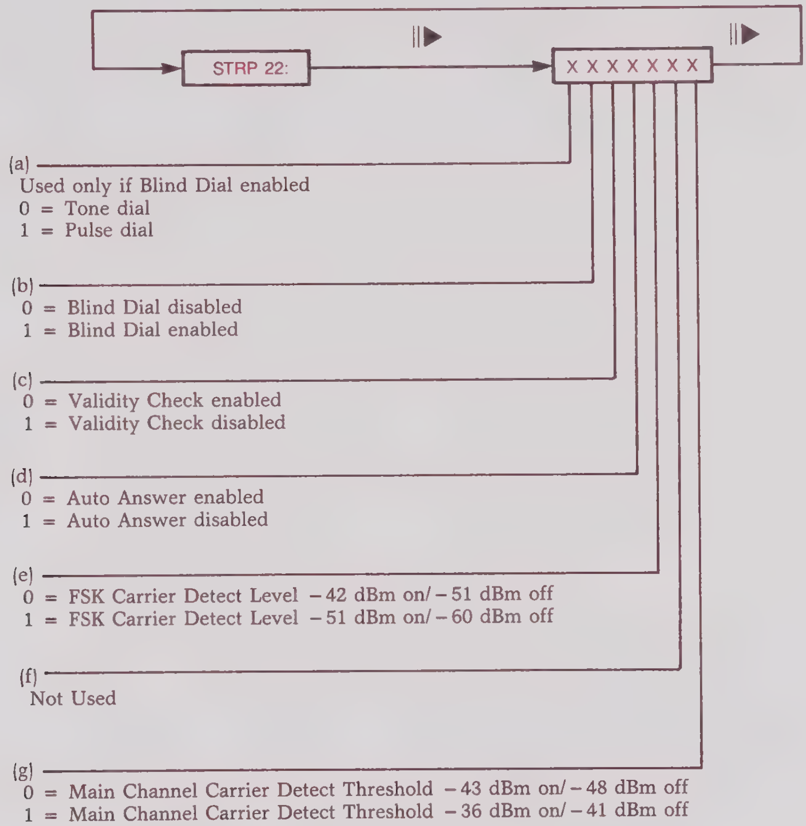
Data Set Control of the Line. To disconnect dial-line service, pull up the exclusion key, press down the receiver button for approximately two seconds, press the exclusion key, and hang up the handset. Do this to both telephones.

Telephone Set Control of the Line. To disconnect dial-line service, place both handsets back on the hook.

MODEM STRAP 22

This strap allows you to select Blind Dial, Validity Check, Auto Answer, FSK Carrier Detect Level, and Main Channel Carrier Detect Threshold options, as described below. Record the Strap 22 configuration on the DDR Option Configuration page in Chapter 3 of the *2600 Series Modem User's Manual*.

- ***Strap (a).*** This strap setting is used only if Blind Dial is enabled; otherwise, it is ignored. If Blind Dial is enabled and your telephone service is limited to pulse dialing, set this strap to "1." If you have tone dialing service, set the strap to "0."
- ***Strap (b).*** The Blind Dial function must be enabled if the modem is inside a private branch exchange (PBX) or using other than the Bell-standard 350/440 Hz dial-tone frequencies. Blind Dial function causes the modem to dial telephone numbers without checking for a dial tone. If this function is enabled, be sure that Strap (a) of Modem Strap 22 is properly selected.
- ***Strap (c).*** This strap provides limited protection against unauthorized telephone calls. It allows the modem to ignore wrong numbers.
- ***Strap (d).*** When the Auto Answer function is enabled, the modem automatically answers incoming calls and transfers to dial-line operation once both telephone lines are connected. If the Auto Answer function is disabled, the modem does not answer telephone calls.
- ***Strap (e).*** This strap allows you to select the FSK Carrier Detect Threshold independently of the main channel. If the secondary channel will not detect carrier at the default setting, changing it to a "1" will allow it to detect carrier at a lower receive level. However, it will be more susceptible to false carrier detects.
- ***Strap (f).*** This strap setting is not used.
- ***Strap (g).*** The Main Channel Carrier Detect Threshold defaults to −43 dBm on/−48 dBm off. If noisy lines are anticipated, the higher setting of −36 dBm on/−41 dBm off is recommended.



(a)
Used only if Blind Dial enabled
0 = Tone dial
1 = Pulse dial

(b)
0 = Blind Dial disabled
1 = Blind Dial enabled

(c)
0 = Validity Check enabled
1 = Validity Check disabled

(d)
0 = Auto Answer enabled
1 = Auto Answer disabled

(e)
0 = FSK Carrier Detect Level −42 dBm on/−51 dBm off
1 = FSK Carrier Detect Level −51 dBm on/−60 dBm off

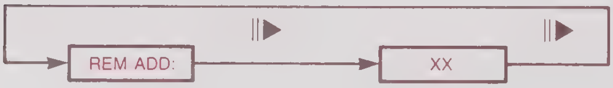
(f)
Not Used

(g)
0 = Main Channel Carrier Detect Threshold −43 dBm on/−48 dBm off
1 = Main Channel Carrier Detect Threshold −36 dBm on/−41 dBm off

■ **Note:** The "0" setting equals the DDR default setting.

REMOTE ADDRESS

The address of the remote modem *must* be stored in this 2-digit Remote Address (REM ADD:) slot. Otherwise, the Terminate with Test selection will not work. The default setting for this address location is 00.



Remote Receive and Transmit (1 to 4)

The DDR Option can store two 32-digit telephone numbers, one remote modem receive (RX) number, and one remote modem transmit (TX) number. Each number is stored in four banks of eight digits each. Initially, these banks are filled with the letter B. ■ **Note:** The A, D, E, and F characters are recognized as blanks when entering a telephone number.

Entering a Telephone Number

To enter a telephone number, follow the instructions in the Numerical Data Entry section in Chapter 4 of the *2600 Series Modem User's Manual*. (Note that the letters A through F follow the numbers 1 through 9 when you advance using the ADV# key). Record both telephone numbers on the DDR Option Configuration page in Chapter 3 of the *2600 Series Modem User's Manual.*

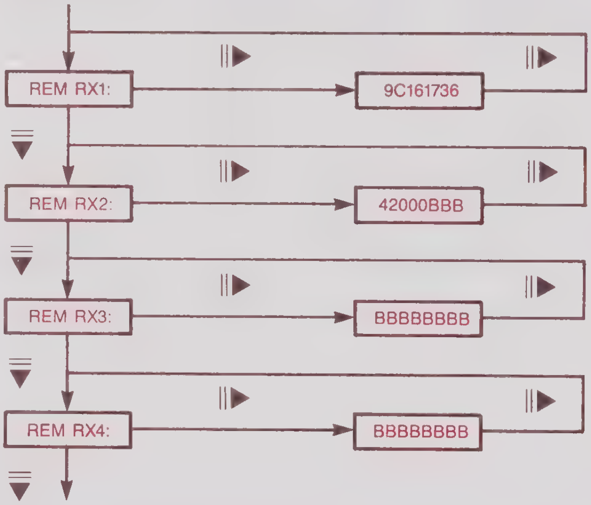
Each telephone number must be directly followed by the letter B, which acts as a stop code. However, if a number occupies all available space, the B is not necessary.

Pauses in Dialing

The letter C in a telephone number causes a 4-second dialing pause. This is necessary if the modem is inside a Private Branch Exchange (PBX) and you must dial a number and wait for a dial tone before continuing to dial. Similar pauses may be required with other common carrier (OCC) types of systems.

The length of a pause can be extended by adding additional C's.

EXAMPLE



■ **Note:** Record telephone numbers on the DDR Option Configuration page in Chapter 3 of the *2600 Series Modem User's Manual.*

Chapter 3
Enhanced Dual Dial Restoral (Enhanced DDR)

Contents

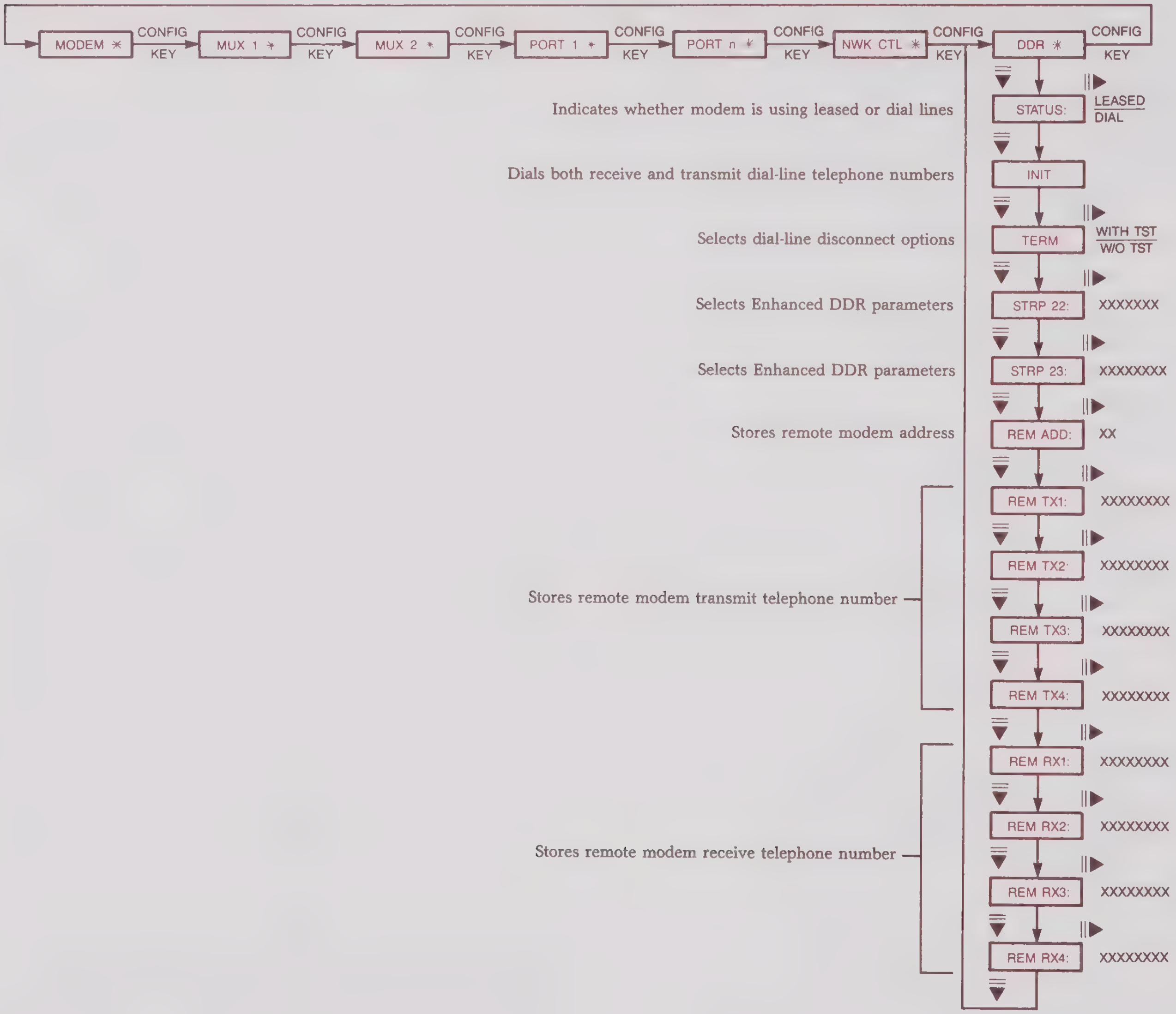
General 3-1
  Modem Strap 22 3-3
  Modem Strap 23 3-4

GENERAL

The Enhanced Dual Dial Restoral (Enhanced DDR) is an optional feature designed to provide greater flexibility for automatic dial backup in your networking system. A new bit on Strap 22 and the new Strap 23 support all of the Enhanced DDR features. These straps allow more choices for the user to ensure automatic functions and yet sustain the standard 2600 DDR ease of configuration for local and remote dial restoral.

The following descriptions give you a definition of the straps and their use in special applications. The enhancements address loss of carrier, modem compatibility, determining leased line conditions, disruptive testing, and dial restoral requirements at unmanned sites. Enabling the straps for the Enhanced DDR gives you additional protection from downtime, maximizing the effectiveness of your dial backup system. Please check with your Codex local applications engineer or salesperson for details on Network Management Systems support for the Enhanced DDR straps.

DDR✳ CATEGORY OF THE 2600 SERIES MODEM CONFIGURATION TREE


MODEM ✳
CONFIG KEY
MUX 1 ✳
CONFIG KEY
MUX 2 ✳
CONFIG KEY
PORT 1 ✳
CONFIG KEY
PORT n ✳
CONFIG KEY
NWK CTL ✳
CONFIG KEY
DDR ✳
CONFIG KEY
Indicates whether modem is using leased or dial lines
STATUS:
LEASED
DIAL
Dials both receive and transmit dial-line telephone numbers
INIT
Selects dial-line disconnect options
TERM
WITH TST
W/O TST
Selects Enhanced DDR parameters
STRP 22:
XXXXXXX
Selects Enhanced DDR parameters
STRP 23:
XXXXXXXX
Stores remote modem address
REM ADD:
XX
Stores remote modem transmit telephone number
REM TX1:
XXXXXXXX
REM TX2:
XXXXXXXX
REM TX3:
XXXXXXXX
REM TX4:
XXXXXXXX
Stores remote modem receive telephone number
REM RX1:
XXXXXXXX
REM RX2:
XXXXXXXX
REM RX3:
XXXXXXXX
REM RX4:
XXXXXXXX

MODEM STRAP 22

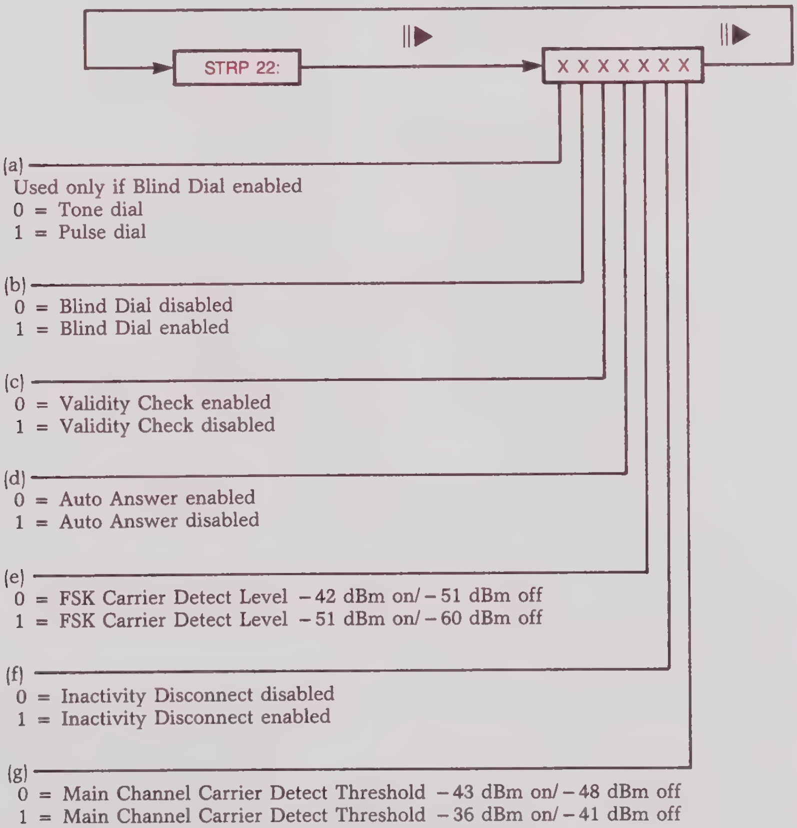
The Enhanced DDR Strap 22, in addition to the features described for Strap 22 in Chapter 2, allows you to select Reverse Dialing or Inactivity Disconnect.

- *Strap (c).* When Validity Check is disabled, this strap allows DDR in the answering modem to accept transmit or receive calls in either order. Enabling Validity Check provides limited protection against unauthorized telephone calls and allows the modem to ignore wrong numbers.

  Application: Validity Check disabled permits compatibility with the 2600 DDR, current Codex dial restoral equipment, and other vendor dial backup units which do not require handshaking. Both point-to-point and multipoint systems are permissible.

- *Strap (f).* When Inactivity Disconnect is enabled in a point-to-point or multipoint slave modem that is in dial backup mode, the modem will switch from dial to leased line operation if carrier goes down for 15 seconds. In addition, this strap selects dial tone disconnect. After 15 seconds of detecting dial tone, the modem will automatically switch to leased line operation.

  Application: This feature is applied only in specific locations in the country where central offices don't provide a holding current reversal when the remote DDR tries to hang up (either because of a power loss or because of a telephone company loss of line).



(a)
Used only if Blind Dial enabled
0 = Tone dial
1 = Pulse dial

(b)
0 = Blind Dial disabled
1 = Blind Dial enabled

(c)
0 = Validity Check enabled
1 = Validity Check disabled

(d)
0 = Auto Answer enabled
1 = Auto Answer disabled

(e)
0 = FSK Carrier Detect Level −42 dBm on/−51 dBm off
1 = FSK Carrier Detect Level −51 dBm on/−60 dBm off

(f)
0 = Inactivity Disconnect disabled
1 = Inactivity Disconnect enabled

(g)
0 = Main Channel Carrier Detect Threshold −43 dBm on/−48 dBm off
1 = Main Channel Carrier Detect Threshold −36 dBm on/−41 dBm off

■**Note:** The "0" setting equals the DDR default setting.

MODEM STRAP 23

This strap is specific to the Enhanced DDR Option. It allows you to select Automatic DDR, DDR Conditional on DTR, DTR Initiates Dial, Periodic Leased Line Check, and Terminate With Test options. Record the Strap 23 configuration on the DDR Option Configuration page in Chapter 3 of the 2600 Series Modem User's Manual.

The Enhanced DDR Strap 23 selections are explained in the following paragraphs.

- *Strap (a).* If Automatic DDR is enabled when the modem is in leased line mode, the modem will automatically switch from leased line to dial backup operation if the carrier goes down for 15 seconds. The modem must be manually transferred back to leased line condition once the problem is corrected, unless Straps (d) and (e) — Periodic Leased Line Check — are enabled (a discussion of these straps appears later in this section).
  ■ **CAUTION:** *Enable the Automatic DDR strap at one end of the line only, to prevent both modems from attempting to initiate dial restoral at the same time. In the unlikely event that the leased line drops out in one direction only, and Automatic DDR is disabled on the modem that has a dead receiver, dial restoral will not be automatically initiated.*

  Application: This feature is applicable in both point-to-point and multipoint slave environments, and in unmanned remote sites.

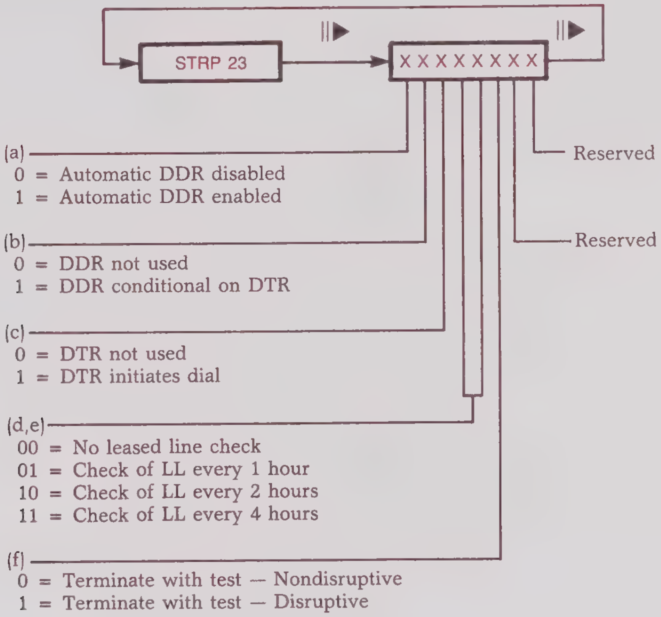
- *Strap (b).* When DDR Conditional on DTR is enabled, DTR On is a necessary condition for the modem to be connected to the dial lines. DTR must be on for a modem to initiate or answer a dial call. If DTR goes off while a dial call is established, the modem will disconnect the dial lines and connect the leased lines. If DTR is down in the answering modem, the modem does not answer and INIT BAD appears on the front panel of the calling modem. DTR has no effect on DDR when this strap is disabled.

  If you initiate a dial sequence with this strap enabled and DTR is down, a DTR DOWN message will be displayed on either the front panel or at the Network Management Systems central site, depending on where the dial sequence was initiated.

  Application: Strap (b) is used to prevent dial calls during leased line operation.

- *Strap (c).* When DTR Initiates Dial is enabled, it allows a DTR high condition to initiate a dial backup call.
  ■ **CAUTION:** *Enable this feature at one end of the dial setup only, to avoid having both modems simultaneously initiate a dial sequence.*

  Application: This feature is applicable in situations that require auto dial capability based on a DTR high condition. When this strap is enabled, all of the functions of Strap (b) apply. In addition, DTR On will initiate a dial sequence if the strap is enabled during leased line operation.



(a)
0 = Automatic DDR disabled
1 = Automatic DDR enabled

(b)
0 = DDR not used
1 = DDR conditional on DTR

(c)
0 = DTR not used
1 = DTR initiates dial

(d,e)
00 = No leased line check
01 = Check of LL every 1 hour
10 = Check of LL every 2 hours
11 = Check of LL every 4 hours

(f)
0 = Terminate with test — Nondisruptive
1 = Terminate with test — Disruptive

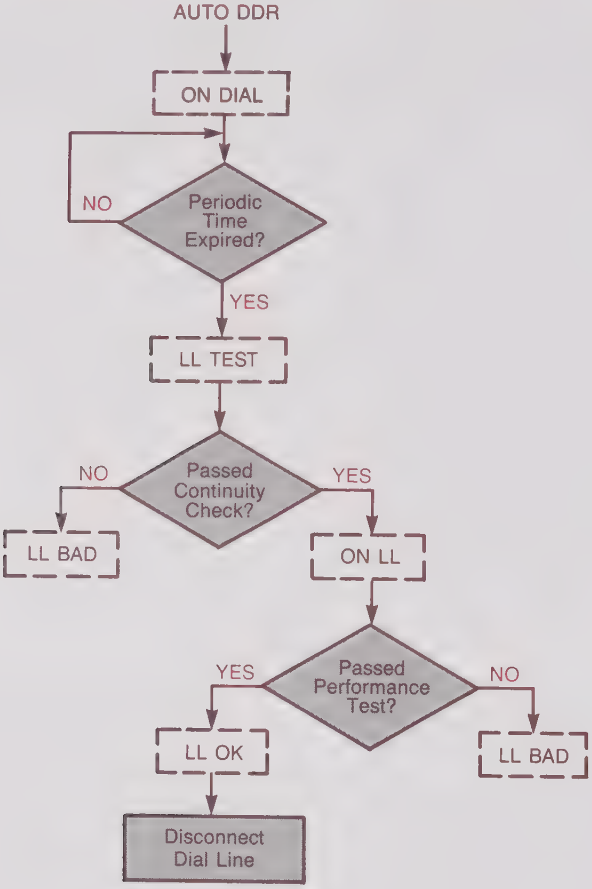
- ***Straps (d) and (e).*** These straps permit automatic termination of dial backup. You can select a Periodic Leased Line Check function for every 1, 2, or 4 hours, or accept the default of 0 (zero), before switching back to leased line operation (see Figure 3-1). The particular termination test selected in Strap (f) is imposed here. This feature assures continuous monitoring of line conditions to avoid unnecessary dial backup operation.

  ■ **CAUTION:** *Enable this feature at one end of the dial setup only, to avoid having both modems simultaneously initiate a termination sequence.*

  Application: The primary application for this feature will be in networks where a site is unmanned and/or Strap (a) — Auto DDR — is enabled.

- ***Strap (f).*** This strap allows two options for Terminate With Test: Test A and Test B. Test A is the default condition and is a nondisruptive feature equivalent to the Terminate With Test option available in the standard DDR described in Chapter 2. Test B enables a disruptive Terminate With Test (36 seconds) which tests for leased line continuity while main channel data is turned off.

  Application: When you are using Terminate With Test on a local loop dial call or in a laboratory test environment with a CO block, and an "LL BAD" message appears on the display, enable Strap (f) to perform Test B instead of a Terminate Without Test command. Note that running Test B will disrupt data for 36 seconds.


AUTO DDR
ON DIAL
NO
Periodic Time Expired?
YES
LL TEST
NO
Passed Continuity Check?
YES
LL BAD
ON LL
YES
Passed Performance Test?
NO
LL OK
LL BAD
Disconnect Dial Line

■**Note:** Items with broken lines contain displayed messages.

Figure 3-1. Periodic Leased Line Check

Chapter 4
Installation Procedures

Contents

FCC Requirements 4-1
  Type of Service 4-2
  Telephone Company Procedures 4-2
  Disconnection 4-2
I/O Assembly 4-2
Direct Connection with Permissive Jacks 4-5
FCC Label 4-6
Printed Circuit Card 4-6
Cable Installation 4-6

FCC REQUIREMENTS

When you are ready to install a 2600 Series modem equipped with the DDR Option, call your local telephone company and report the following information:

- The telephone number of the line to which you will connect the 2600 Series modem
- The FCC registration number of the modem: AT993A-13946-MD-E
- The ringer equivalence number (REN) of the modem: 0.3B

The 2600 Series modems connect to the telephone line by means of a standard USOC RJ41S or RJ45S jack. If this type of jack is not available where you want to install your 2600 Series modem, you must order it from the telephone company.

If exclusion-key telephones are used, RJ36X jacks are also required.

If direct connection with no line control is desired, a permissive jack arrangement (RJ11C *only*) is possible on 2600 Series modems.

Type of Service

Your 2600 Series modems are designed to be used on standard-device telephone lines. They should not be used on coin-service lines or party lines.

If you have any questions about your telephone line, such as how many pieces of equipment you can connect to it, the telephone company will provide this information upon request.

Telephone Company Procedures

The telephone company may occasionally make changes in its equipment, operations, or procedures. If these changes are likely to affect your service or the operation of your equipment, the telephone company will give you written notice to allow you to make any changes necessary to maintain uninterrupted service.

If any of your telephone equipment is not operating properly, you should immediately remove it from your telephone line, as it may cause harm to the telephone network. If the telephone company notes a problem, it may temporarily discontinue service. When practical, it will notify you in advance of this disconnection. If advance notice is not feasible, you will be notified as soon as possible. When you are notified, you will be given the opportunity to correct the problem and will be informed of your right to file a complaint with the FCC.

In the event that repairs are needed on your 2600 Series modem, they should be performed by Codex Corporation or an authorized representative.

Disconnection

If you decide to permanently disconnect your 2600 Series modems from their present lines, report this change to the telephone company.

I/O ASSEMBLY

Before proceeding, turn the modem off and disconnect the power cord.

1) Label all connectors before removing them to assist you when reconnecting.
2) Unplug all connectors from the back of the modem.
3) Loosen the right side of the rear dress panel by inserting a screwdriver between the dress panel and the right side of the box. Gently pry the panel loose (see Figure 4-1). Once the right side of the panel is loosened, insert the screwdriver into the slots on the bottom and top of the panel and gently pry the entire panel free from the box.
4) Remove the bottom knockout on the rear dress panel.
5) If your modem does *not* have the 6-port Multiplexer Option, take off the metal back plate by removing the three Phillips-head screws fastening it to the modem. Slide the plate to the right until the slots on the bottom and top of the plate align with the pegs holding the plate in place (see Figure 4-2).
6) If your modem *has* the 6-port Multiplexer Option, first unscrew the four hex nuts attaching the flex cable to the metal back plate using a 3/16-inch hex-nut driver. Then gently fold the flex cable to the right so it will be out of the way when you remove the metal back plate, as described in Step 5 above.
7) Mount the telephone-jack bracket on the I/O assembly to the bottom slot on the metal back plate using the two screws provided.

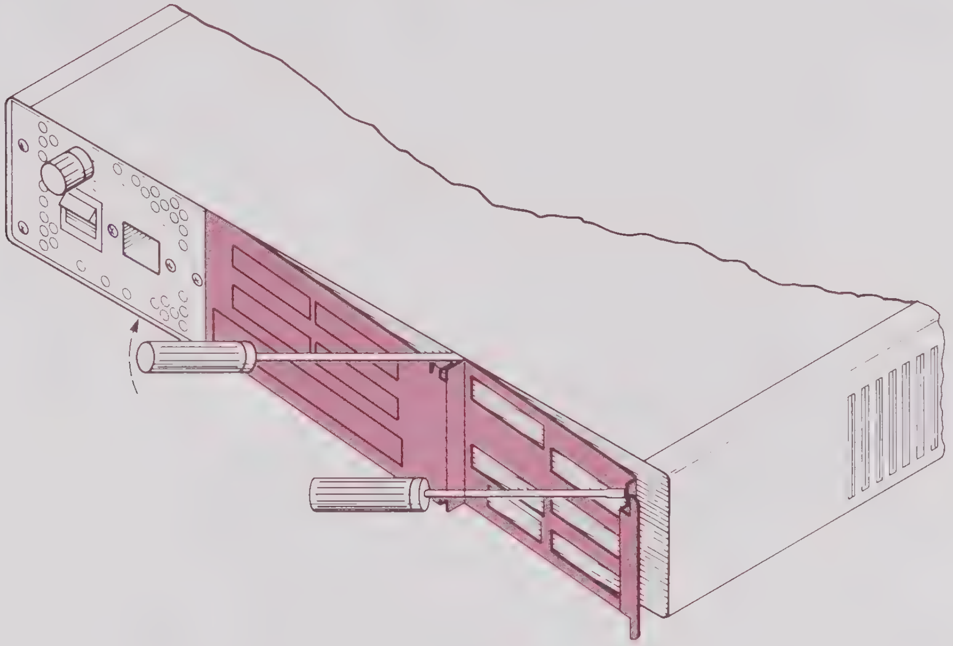


Figure 4-1. Removing the Rear Dress Panel

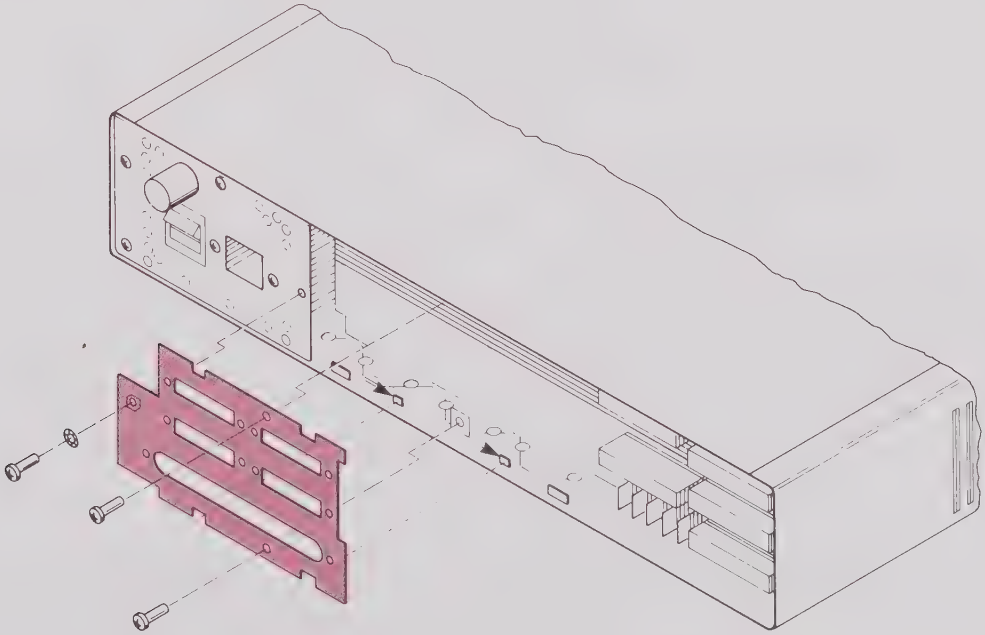


Figure 4-2. Removing the Back Plate

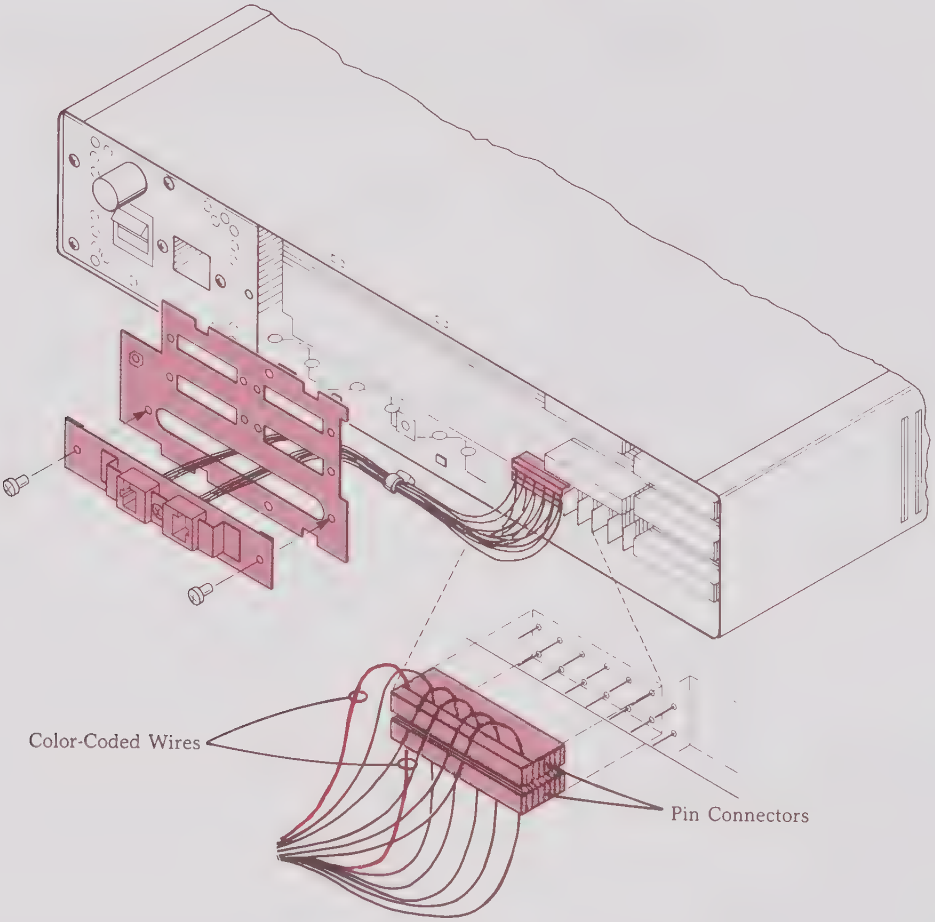


Figure 4-3. Installing the Pin Connectors

8) Plug the two pin connectors on the other end of the cable assembly into the back of the modem as follows (see Figure 4-3):

   - Locate the two rows of pins to the left of the terminal block on the lower right side of the exposed modem backplane.
   - With the color-coded wires on the left, as shown in Figure 4-3, plug the connectors into the pins. Leave the pin that abuts the terminal block on each connector free. The prelabeled P1 connector should be on the top; the P2 connector should be on the bottom.

     ■ **CAUTION:** *Leaving more than one pin free at the top or the bottom can cause damage to the DDR card.*

9) Replace the metal back plate and the three securing screws.

10) If your modem has the 6-port Multiplexer Option, refasten the flex cable connectors to the metal back plate with the four hex nuts.

11) Reinstall the rear dress panel.

12) Reinstall all cables.

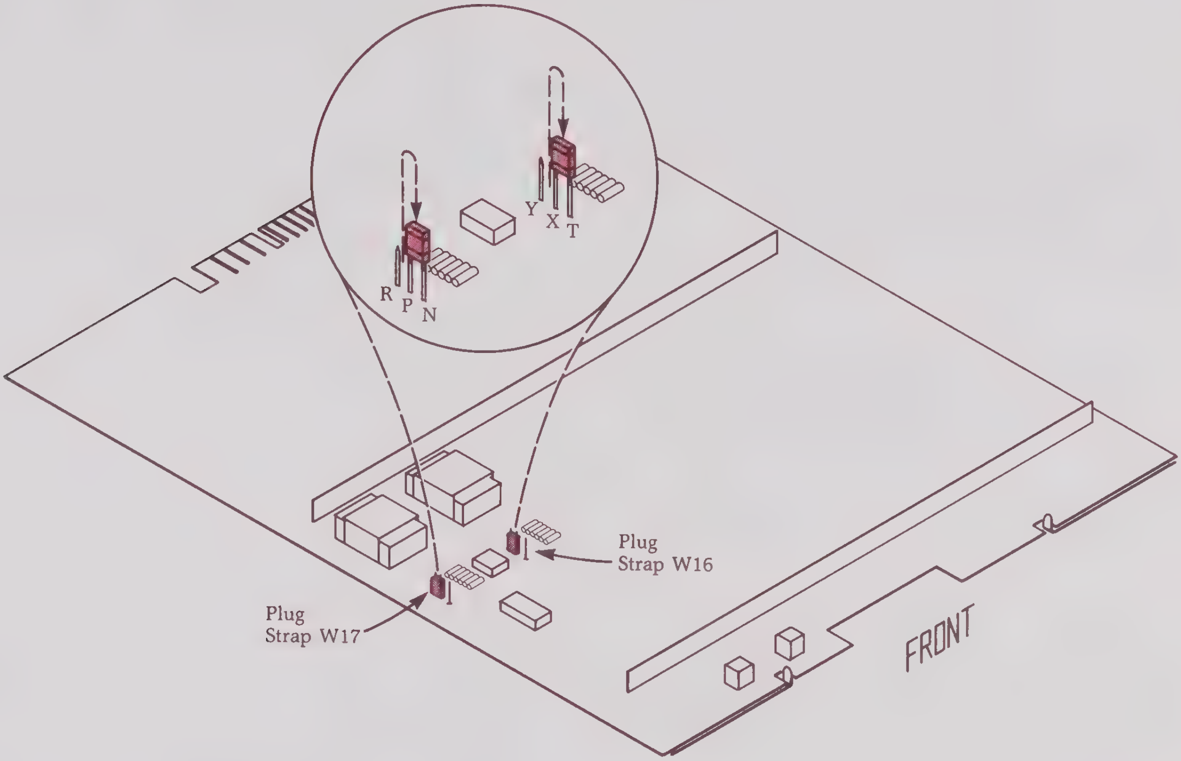


Figure 4-4. Permissive Plug Strap Arrangement on DDR PC Card

DIRECT CONNECTION WITH PERMISSIVE JACKS

Take the following steps to ensure proper setup and operation of high-speed 2600 modems with permissive jacks:

1) Connect the 2600 modem with DDR Option to two RJ11C wall jacks, using 8- to 6-position modular cables (Part No. 06625).

2) Change plug straps W16 and W17 on the DDR PC Card, as shown in Figure 4-4 and as listed below:

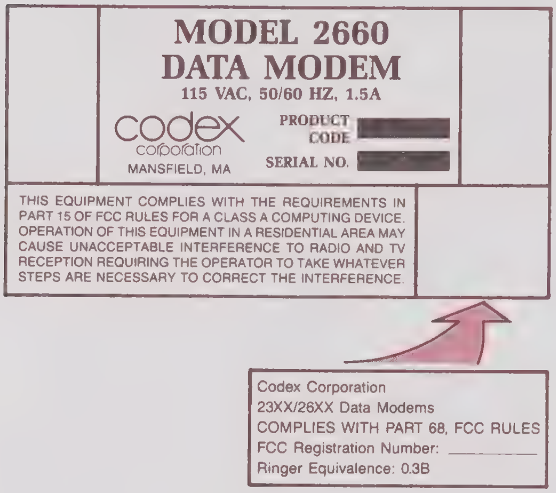
Plug Strap	*Programmable Arrangement*	*Permissive Arrangement*
W16	X-Y	X-T
W17	P-R	P-N

■ **Note:** The solder straps for both programmable and permissive configurations are factory installed as listed below:

- W3, W5, W7, W9 — In
- W2, W4, W6, W8 — Out

3) Configure the 2600 modem for Auto Call without telephones.

■ **CAUTION:** *No other piece of equipment except the 2600 Series modem itself should be attached at the RJ11C wall jack.*



MODEL 2660
DATA MODEM
115 VAC, 50/60 HZ, 1.5A
codex corporation
MANSFIELD, MA
PRODUCT CODE [redacted]
SERIAL NO. [redacted]

THIS EQUIPMENT COMPLIES WITH THE REQUIREMENTS IN PART 15 OF FCC RULES FOR A CLASS A COMPUTING DEVICE. OPERATION OF THIS EQUIPMENT IN A RESIDENTIAL AREA MAY CAUSE UNACCEPTABLE INTERFERENCE TO RADIO AND TV RECEPTION REQUIRING THE OPERATOR TO TAKE WHATEVER STEPS ARE NECESSARY TO CORRECT THE INTERFERENCE.

Codex Corporation
23XX/26XX Data Modems
COMPLIES WITH PART 68, FCC RULES
FCC Registration Number: ________
Ringer Equivalence: 0.3B

Figure 4-5. Placement of FCC Part 68 Registration Label

FCC LABEL

Turn the modem over so that the manufacturing label is visible. Place the FCC Part 68 registration label in the lower right-hand corner of the manufacturing label, as shown in Figure 4-5.

PRINTED CIRCUIT CARD

Follow the instructions below for inserting your DDR card.

■ **CAUTION:** *Be certain that the modem is powered off before removing or inserting a DDR card.*

1) Lower the Control Panel.
2) Slide the Data Pump card out about two inches (5.08 cm).
3) Remove the Control Panel. It may be necessary to use a screwdriver to lift the tabs connecting the Control Panel to the modem.
4) Gently lay the Control Panel on top of the Data Pump card, being careful not to disturb the ribbon cable connection.
5) Slide the DDR card into the bottom card position, using the injectors/extractors at the front of the card, until it is firmly seated in the connector in the back of the modem.
6) Replace the Control Panel.
7) Reseat the Data Pump card.
8) Close the Control Panel.

■ **Note:** See Chapter 5 in the *2600 Series Modem User's Manual* for information on voltage checks for all PC cards.

CABLE INSTALLATION

Perform the following steps for cable installation:

1) Plug one of the 8-pin modular plugs on the receive cable into the modular jack labeled RX on the back of the modem.
2) Plug one of the 8-pin modular plugs on the transmit cable into the modular jack labeled TX on the back of the modem.
3) Plug the other end of the transmit cable into the telephone company jack.
4) Plug the other end of the receive cable into the telephone company jack.
5) Enter the local telephone numbers on the DDR Option Configuration page in Chapter 3 of the *2600 Series Modem User's Manual*.

2600 Series DDR
User's Guide
Part No. 08128, Rev C
March 1986

USER/READER COMMENTS

In order to improve the quality and utility of its manuals, Codex Corporation needs the active cooperation and participation of its user readership. Your comments as a user/reader will be greatly appreciated and reviewed for incorporation in the next revision of this manual.

Please comment on this manual's completeness, accuracy, organization, usability, and readability.

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Did you find errors in this manual? If so, specify by page.

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How can this manual be improved?

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2600 Series XL PAD User's Guide

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2600 Series XL PAD
User's Guide

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User Questionnaire

A prepaid user questionnaire is provided in the back of this manual for your comments. Codex welcomes your comments; your input is important in helping us improve the effectiveness of this manual. Thank you.

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

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Project Editor: Michael Joyce
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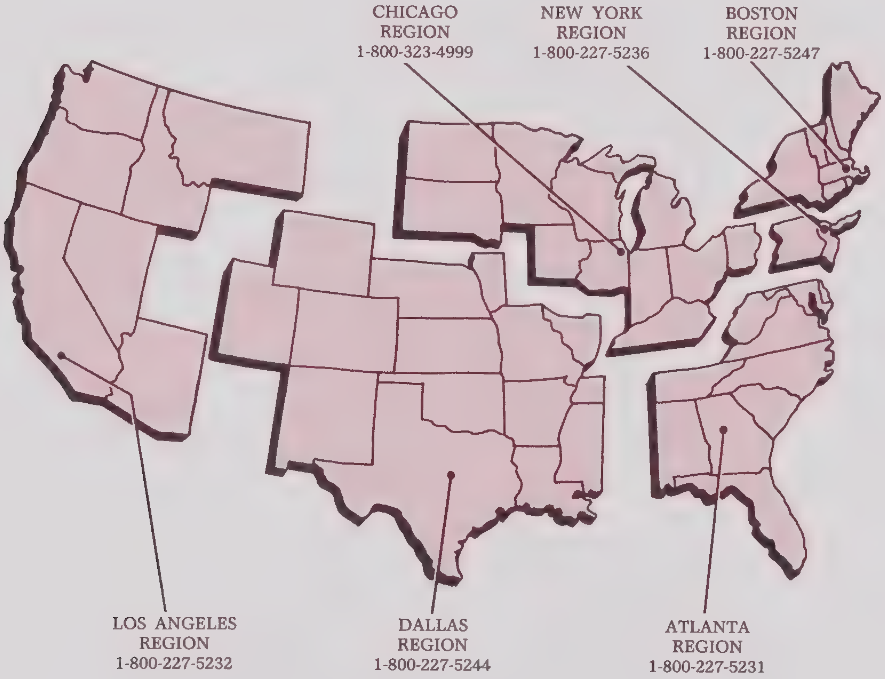
Codex Customer Service

This User's Guide has been written to help you understand, install, and use your Codex product. For further technical assistance, please contact the Codex Customer Service office in your area during normal business hours. Use the map below to determine the telephone number to call.


CHICAGO
REGION
1-800-323-4999
NEW YORK
REGION
1-800-227-5236
BOSTON
REGION
1-800-227-5247
LOS ANGELES
REGION
1-800-227-5232
DALLAS
REGION
1-800-227-5244
ATLANTA
REGION
1-800-227-5231

Contents

Preface vii

Chapter 1. Introduction
Overview 1-1
Interactive Terminal Interface Standard 1-2
  X.3 1-2
  X.28 1-3
  X.29 1-3
Addressing and Switched Virtual Circuits in the XL PAD 1-3
  Destination Addressing for Outgoing Calls to a Remote DTE 1-3
  Calling Address for Outgoing Calls to a Remote DTE 1-4
  Listen Addressing for Incoming Calls to a Local DTE 1-4
  Alternate Listen Addressing for Incoming Calls to a Local DTE 1-5
  Wild-Card Feature 1-6
Features Summary and Descriptions 1-7

Chapter 2. Applications
Overview 2-1
Installation 2-2
Compatibility with 2600 Series Modems 2-2
EIA Interface Signals 2-3
Network Configurations 2-4
  Remote Host Concentration to an X.25 PSN 2-5
  Remote Terminal Concentration to an X.25 PSN 2-5
  Statistical Time Division Multiplexing (STDM) 2-7
  Remote Terminal Concentration to an X.25 Host 2-7
  TDM/X.25 Hybrid Network 2-8
  Multiple XL PAD Concentration with an Intelligent X.25 Processor (IXP) 2-8

Contents (continued)

Chapter 3. Initial Setup of PAD Parameters

General 3-1
Setting Modem Parameters 3-2
Using the Control Channel 3-4
Setup of XL PAD Parameters 3-6
  X.25 (Network Port) Parameters 3-8
  Async Port Parameters 3-12
  Control Channel 3-28
  Broadcast 3-30
  Auto Call Parameters 3-32

Chapter 4. Rebooting the PAD

General 4-1
Start Over on a Port 4-2
Restart Packet Level 4-3
Reboot the PAD 4-3
Reinstate Factory Parameter Settings 4-3
Reboot the Entire System 4-3

Chapter 5. Using the PAD

General 5-1
Data Transfer Mode 5-2
  Placing Calls 5-2
  Clearing Calls 5-2
Command Mode 5-3
  Accessing the Command Mode 5-3
  Commands 5-3
The Incoming Call Display 5-9

Chapter 6. PAD Diagnostics

General 6-1
Self Test 6-3
Status 6-4
  X.25 Network 6-5
  Async Port Status 6-6
  Software Release Date 6-7
  System Status 6-7
Performance Statistics 6-8
  View X.25 Statistics 6-8
  View Async Statistics 6-9
  Clear X.25 Statistics 6-11
  Clear Async Statistics 6-11
  Clear All Statistics 6-12
  View System Statistics 6-12
  Clear System Statistics 6-12
  View Broadcast Statistics 6-12
  Clear Broadcast Statistics 6-13
Diagnostics 6-13
  Packet Level Probe 6-13
  Packet Level Trace 6-13
X.25 Cause Codes and Diagnostic Codes 6-14

Chapter 7. Reference

Configuration Worksheets 7-1
  Address Records 7-1
  X.25 Parameters 7-4
  Per Port Parameters 7-6
  X.3 Profiles 7-9
  All Ports Parameters 7-10
  Broadcast Parameters 7-10
X.3 Parameter Guide 7-11
XL PAD Command List 7-16
Cause Codes for Clear Indication, Reset Indication, and Restart Indication Packets 7-18
Diagnostic Codes for Clear, Reset, and Restart Indication, Registration Confirmation, and Diagnostic Packets 7-19
Decimal/Hexadecimal/ASCII Conversion Chart 7-22

Preface

The PAD (packet assembler/disassembler) XL Option for 2600 Series Modems enables you to access an X.25 packet switched network with up to eight asynchronous terminals. This user's guide describes how to configure and use the XL PAD to create your own X.25-compatible network. It is assumed that you have already read the Codex *2600 Series Modem User's Manual* and that you have some familiarity with 2600 Series Modems and the protocol described in CCITT recommendation X.25. This *User's Guide* is divided into seven chapters:

Chapter 1 is a general overview of packet switching, CCITT specifications governing packet switching with asynchronous DTEs, and addressing.

Chapter 2 describes how to connect your asynchronous terminals to the XL PAD and how to set up X.25 networks using the XL PAD.

Chapter 3 tells you how to perform the initial configuration of the XL PAD using one of your asynchronous terminals to access the control channel.

Chapter 4 describes how to reboot the XL PAD to load your configuration settings into the PAD's permanent memory.

Chapter 5 outlines the procedures for placing virtual calls and disconnecting virtual circuits. This chapter also describes XL PAD commands.

Chapter 6 describes the procedures for gathering statistics related to XL PAD operation and also describes how to isolate the status of the XL PAD, async ports, and X.25 frame and packet levels.

Chapter 7 contains reference information and worksheets that help you to configure and monitor the XL PAD.

Chapter 1
Introduction

Contents

Overview 1-1
Interactive Terminal Interface Standard 1-2
  X.3 1-2
  X.28 1-3
  X.29 1-3
Addressing and Switched Virtual Circuits in the XL PAD 1-3
  Destination Addressing for Outgoing Calls to a Remote DTE 1-3
  Calling Address for Outgoing Calls to a Remote DTE 1-4
  Listen Addressing for Incoming Calls to a Local DTE 1-4
  Alternate Listen Addressing for Incoming Calls to a Local DTE 1-5
  Wild-Card Feature 1-6
Features Summary and Descriptions 1-7

OVERVIEW

Packet switched networks are becoming increasingly popular for data transmission over long distances, especially in interactive applications. Data in such networks is sent in the form of packets, which are discrete blocks of data containing address, error checking, user data, and control bits. Because packet construction ensures that a packet is received in the correct sequence at the correct DTE, packets can be interleaved on a single link, providing statistical multiplexing benefits. When packets are received at a remote destination, they are checked for errors, distributed to the proper DTE according to an address in the packet, and acknowledged. Communications are full-duplex in most packet switched networks, allowing a DTE to transmit and receive packets at the same time.

One widely used packet switched protocol is defined by CCITT recommendation X.25. This recommendation specifies physical interface, packet, and frame protocols for the operation of DTEs or DCEs in the packet switched mode. The X.25 protocol provides a reliable method of transmitting packets over a network, but it is complex and expensive to incorporate into every terminal. Recognizing the need for access to packet switched data networks with asynchronous (non-X.25-equipped) terminals, the CCITT created recommendations X.3 and X.28 to define how these terminals could access an X.25 network with a packet assembler/disassembler (PAD) device. The CCITT also issued recommendation X.29 to govern PAD to PAD or PAD to X.25 host communications across a network.

The XL PAD Option for the Codex 2600 Series Modems is an integral X.25 PAD for use with asynchronous devices. The PAD is incorporated into 2600 Series Modems with a factory-installed DTX card, which replaces the DTE card. The DTX card contains additional PAD hardware and software to allow most kinds of asynchronous terminals to access an X.25 network. For simplicity, your 2600 Series unit with its integral PAD option will be referred to as the XL PAD throughout this manual.

The XL PAD allows you to:

- Access an X.25 packet switched network remotely with a non-X.25 host computer or up to eight async terminals.
- Permit up to eight async terminals to access a remote X.25 compatible host.
- Create a statistical time division multiplexing (STDM) network by using two XL PADs to permit packet switched communications between a non-X.25 host and up to eight async terminals.
- Time division multiplex up to two terminals with nonpacket switched protocols while using X.25 packet assembly/disassembly for six or seven async terminals.
- Configure a medium-sized X.25 network using multiple XL PADs and a Codex 6510 Intelligent X.25 Processor (IXP). See Chapter 2 for a detailed example of this type of network.

INTERACTIVE TERMINAL INTERFACE STANDARD

CCITT recommendations X.3, X.28, and X.29 make up the set of specifications sometimes referred to collectively as the Interactive Terminal Interface Standard. When implemented in a PAD, the three recommendations permit X.25 operation for async terminals. The XL PAD follows the guidelines in all three of the recommendations, which are described in the following sections.

X.3

The X.3 recommendation specifies how the XL PAD assembles and disassembles the packets it receives from and sends to its attached async terminals. The 1984 version of X.3 lists a set of 22 parameters that dictate PAD functions in relation to each async terminal or port. The entire group of parameter settings must be configured for every async terminal attached to the XL PAD unless the default settings are desired. For example, Parameter No. 2 of the X.3 recommendation determines how the XL PAD will echo characters for a local async terminal. When this parameter is set to 1, the XL PAD must echo characters back to the same local async terminal where the characters were keyed in; a setting of 0 means that the XL PAD will not echo characters back to the local async terminal.

In addition to the 22 parameters specified by the 1984 version of X.3, the XL PAD also has 4 extra parameters. The extra XL PAD parameters allow you to select a half-duplex mode and to change the way the XL PAD processes tab characters. These extra parameters have been added to enable the XL PAD to accommodate different brands of async terminals. See Chapter 7 for a more complete description of the extra parameters.

In addition to allowing individual configuration of the X.3 parameters, the XL PAD also stores sets of parameter settings called profiles. Each profile is a set of parameters (22 X.3 and 4 extra) customized for a particular application or async device. The XL PAD allows you to select one profile for each port to determine how the XL PAD will assemble and disassemble packets for the attached async terminal.

For a complete description of each of the X.3 parameters and their possible settings in the XL PAD, see the guide in Chapter 7 or view the help text available through the XL PAD control channel as described in Chapter 3.

X.28

The X.28 recommendation defines the commands an asynchronous DTE can issue to cause the PAD to:

- Initiate and disconnect virtual circuits with the remote DTE.
- Send Interrupt and Reset Packets.
- Modify how the PAD functions by changing selected X.3 parameters or profiles.
- Report the status of the X.25 network link.
- Advise and/or revise an X.3 parameter value or values currently in effect for a port.

The X.28 recommendation also specifies a set of service signals that are PAD responses to the command signals it receives from the local terminal. If you enter the CLEAR command for instance, the XL PAD might return the service signal CLR CONF confirming that the clear command has been carried out. Service signals displayed on your screen by the XL PAD are self-explanatory, and therefore not described in this guide. See the "Commands" section of Chapter 5 for the X.28 commands used in the XL PAD.

X.29

X.29 messages are similar in function to the X.28 commands and responses, but apply to the control messages used between your local XL PAD and a remote PAD or X.25-compatible DTE. In the XL PAD implementation of X.29, the XL PAD responds to all X.29 messages except "DTE Reselection" and sends most other messages. X.29 messages supported by the XL PAD are described in the "Commands" section of Chapter 5.

ADDRESSING AND SWITCHED VIRTUAL CIRCUITS IN THE XL PAD

The Switched Virtual Circuit (SVC) is a perceived conduit for packets sent from one end of an X.25 network to the other. The SVC is established by placing a virtual call from an X.25 device or an async terminal/PAD combination. No dedicated physical connection actually exists between the two ends of a network, but through the use of the addressing, sequencing, and logical channel fields in packets, flow paths are established to ensure that packets will arrive in order at the proper destination. These flow paths can change from one virtual call to another, depending on which logical channel numbers are assigned by the XL PAD or remote X.25 device.

The XL PAD uses SVCs to establish connections between local and remote DTEs through a combination of addresses. The addressing format of the XL PAD follows the guidelines of the international numbering plan described in CCITT recommendation X.121, but also adds several more convenient ways of addressing unique to the XL PAD. For most applications, the factory default addresses are recommended. The next sections describe addressing in the XL PAD: all addresses are configured either with an XL PAD (X.28) command or through the control channel (described in Chapter 3) if a command is not specified.

Destination Addressing for Outgoing Calls to a Remote DTE

There are three types of destination addresses for outgoing calls.

CALL Command Addressing. As described in Chapter 5, you can establish an SVC to a remote DTE by entering the CALL command from your local terminal followed by the 1- to 15-digit address of the remote DTE. If the remote DTE uses the X.121 addressing scheme, the address will contain:

- A DTE address specifying the remote X.25 DTE or PAD.
- A subaddress, to route the incoming packets to a specific port or channel.

Mnemonic Addresses. Names of up to 10 alphanumeric and underscore (_) characters can be entered to take the place of the 15-digit address described above. The mnemonic address is configured through the XL PAD's control channel as described in Chapter 5. An example of a mnemonic address is the factory preset name CTP for the control channel. You can initiate a virtual circuit with the control channel by placing a virtual call with either the control channel mnemonic address CTP or its equivalent (factory preset) destination address of 89.

Auto Call. You can enter the 15-digit address of a remote DTE you want to call every time from the same terminal. When you power on the local terminal, a virtual call will be placed automatically to the local control channel or a remote DTE address you have entered in the XL PAD.

Calling Address for Outgoing Calls to a Remote DTE

When you initiate a virtual call to a remote DTE, you can also identify the local DTE you are calling from. The calling address can be inserted into outgoing packets so the remote DTE knows where the packet came from. This type of address is configured in two ways in the XL PAD:

PAD Calling Address. This calling address identifies the address of the XL PAD in relation to a network. From the point of view of an X.25 network, the XL PAD is usually seen as a DTE (the PAD is transparent to the network). When the remote X.25 device or XL PAD receives a call request packet containing this address, it will know which connection point on the network the call request packet was sent from. The PAD calling (network) address can be from 1 to 15 digits long.

Async Port Calling Address. This address (it is actually a *sub*address) informs the remote end which terminal is calling. The async port address may include the PAD calling address, and is 1 to 15 digits in length. The async port address is combined with the PAD calling to show exactly which XL PAD and async terminal the call request packet was sent from.

■ **Note:** When you initiate a virtual call to a remote DTE, the async port address is appended to the PAD calling address in outgoing call request packets. When you enter the DTE and async port calling addresses described above, the combined PAD/async port calling address cannot exceed 15 digits. As an example, if you enter a PAD calling address of 12 digits, each async port address should not exceed 3 digits, because a longer async port calling address would exceed the 15-digit maximum. If the total digits in the combined PAD/async port calling address exceeds 15, the XL PAD will drop digits from the async port calling address. See Table 1-1 for examples of how the PAD and async port calling addresses are merged.

Listen Addressing for Incoming Calls to a Local DTE

The local XL PAD needs a way to screen incoming call request packets from the network to make sure they should be accepted. The XL PAD then has to distribute call request packets it has accepted to the appropriate local async port or channel. The XL PAD has two types of ''listen'' addresses to accomplish this:

LISTEN Command Addressing. You can specify a listen address for the async port you are using by entering the LISTEN command followed by an address of up to 15 digits. (See Chapter 5.) If you do not use the LISTEN command to specify a listen address for the async port you are using, the XL PAD will use a default listen pattern as described below.

Default Listen Pattern. This pattern (address) is used by your local XL PAD for internal packet routing to each of the async ports if a listen address has not been specified with the LISTEN command as described above. If you enter a Default Listen Type of ADDR, the pattern can be from 1 to 15 digits long; if you have entered a Default Listen Type of DATA, the pattern can be 1 to 12 characters long, and can contain hex characters, ASCII characters, or both. The called address of an incoming call request packet must match the default listen pattern you enter in order to be routed to the local async port.

Control and Broadcast Channel Network Addresses. The network addresses for the control and broadcast channels are listen addresses similar to those described above, but the incoming call request packets with matching destination addresses are routed to the control or broadcast channels in the XL PAD rather than to the local async ports.

Table 1-1.
Use of Wild-Cards in Async Port Addresses

PAD Calling Address	*Async Port Calling Address*	*Calling Address (in outgoing call request packets)*
9876543210123	*01	987654321012301
9876543210123	01 (No wild card)	01
987654321012345	10*	109876543210123
987654321012345	???1	9871
987654321012345	??10?	98107
987654321012345	*01	987654321012345
9876543210123	1*0	198765432101230
987654321012345	*	987654321012345

Note that one listen address can be assigned to several async ports. You may wish to do this to create an informal hunt group. If an incoming call request packet has a destination (called) address matching the listen address of several ports, the call will be routed to the first free port within the group, starting with the lowest-numbered port. The hunt group feature is available only for the async ports; it cannot be used on the control or broadcast channels.

Alternate Listen Addressing for Incoming Calls to a Local DTE

In rare instances, networks may not offer the capability of combining a DTE address and a subaddress to direct call request packets to channels or ports. In these networks, 16 characters of the user data field may be used to insert further addressing information to take the place of a subaddress. Four alternate listen address features are used in the XL PAD to accommodate user data field addressing. User Data Pattern and User Data Mask are used only for incoming calls on broadcast(s) and control channels. Default Listen Pattern and Default Listen Type are used only for incoming calls on async ports.

User Data Pattern. This pattern is similar to the default listen address described in the preceding section; however, the user data pattern can be entered in hexadecimal or ASCII characters, or both. If you enter ASCII characters in the User Data Pattern, you must enclose them in quotes. For example, you could enter the user data pattern 060107 "NEW_YORK", which combines hex and ASCII characters in the same address.

User Data Mask. Before the user data fields of incoming call request packets are compared to the user data pattern described above, both are first screened by the user data mask. The mask acts as a screen by allowing the XL PAD to compare only certain character positions in the user data field of incoming call request packets against the same character positions in the user data pattern. You can use this feature to provide greater access to the control port or broadcast channels through the use of abbreviated addressing. If you mask more characters, access to the control port or broadcast channels becomes less restricted. Information on how to enter user data patterns and masks is explained further in Chapter 3.

Default Listen Pattern. This pattern is used between active sessions and when no patterns are specified at the command interface. It consists of up to 15 decimal digits (no wild-cards) if the default listen type is ADDR, or up to 12 digits if the default listen type is DATA. X.25 call request packets which match the listen pattern are accepted by the PAD.

Default Listen Type. This specifies the call request field to match against the listen pattern. ADDR is the called address field. DATA represents the user data field. NONE means the port will not accept calls.

Wild-Card Feature

Two characters can be used in the XL PAD to replace one or several characters in two types of addresses. The wild-card characters are provided mainly to reduce the number of characters you are required to enter for various types of addresses. The two wild-card characters you can use in addressing are:

- * The asterisk wild-card can be used to replace any number of digits in an address, depending on its placement. See the examples later in this section for ways to use this character.
- ? The question mark wild-card can be used to replace only one digit in an address. Again, see the examples later in this chapter for ways to use this character.

Some restrictions apply to the use of wild-card characters. Observe the following rules when using wild-card characters in addresses:

- Wild-card characters can only be used in the async port (calling) address and the network (listen) addresses for the control and broadcast channels.
- Wild-card characters cannot be used in the async port default listen pattern, the address following the LISTEN command, nor the PAD calling address.
- A listen address cannot consist of one question mark (?) wild-card character, because the XL PAD will treat this as a request for help text.

Wild-card characters are used in two types of addresses in the XL PAD. To learn how the wild-cards are used in these addresses, see the following two sections. For further descriptions of the addresses and how to configure them, consult Chapter 3.

Wild-Card Use in Async Port (Calling) Addresses. Wild-card characters are used with the async port address to merge it with the PAD calling address (of the entire XL PAD) for inclusion in the calling address field of call request packets going out to the network. When you enter wild-card characters in the async port (calling) address, the PAD adds or substitutes digits from the PAD calling address to replace the wild-card characters. See Table 1-1 for some examples of how wild-card characters can be used in async port calling addresses.

In the examples shown in Table 1-1, notice that there is a 15-digit maximum for the calling address field of the outgoing call request packet: if the total of the PAD calling and async port calling addresses exceeds 15 digits, digits will be deleted from the PAD calling address (or async port calling address, if wild-card characters are used in certain combinations). In addition, if you do not use wild-card characters in the async port calling address, the calling address field of call request packets will *not* contain any characters from the PAD calling address.

Wild-Card Use in Control and Broadcast Channel Network (Listen) Addresses. When used in network (listen) addresses for the control and broadcast channels, wild-cards are used for abbreviated addressing, eliminating the need for a remote caller to enter all 15 digits of the called address to direct an incoming call request packet to a local control or broadcast channel. For example, for broadcast channel 1 you might enter a network (listen) address of *81, thereby permitting any call request packet containing a called address with the last two digits 81 to be routed to broadcast channel 1. See the following for some examples of the called addresses in call request packets that would match a network (listen) address of *81.

```
603335555556681

BOSTON_81

81
```

Table 1-2.
XL PAD Features Summary

Feature	*Description*
Asynchronous Support	Permits most types of asynchronous terminals to use packet switched networks. Available in 4- or 8-port configurations.
2600 Series Integrated	Factory installed in 2600 Series Modems. Eliminates need for separate PAD and additional cabling. Reduces space requirements and cost.
CCITT Compatibility	Follows principles set forth in CCITT recommendations X.25, X.3, X.28, X.29, and X.121 as they apply to the use of asynchronous terminals in packet switched networks.
SVC Support	Allows user to establish switched virtual circuits to any remote DTE in a packet switched network by specifying the DTE address.
Dial-in Support	Terminal ports can be configured for dial-in modem connections with optional automatic speed and parity detection.
Control Channel	Permits local or remote access to all the PAD's packet switching parameters. The control channel also supplies diagnostic information concerning the PAD's operation and performance.
Auto Call	Automatically places a virtual call to an address predetermined by the user when the local terminal is powered on.
Broadcast Channels	Allow the PAD to receive up to eight simplex data streams (bulletin channels). The XL PAD can also duplicate messages received on any one of these channels for retransmission to as many as eight async ports.
Hunt Groups	One listen address can be specified for several async ports so that calls coming into the XL PAD from the network will be routed to the first free async port in the group.
TDM Support	The XL PAD can time division multiplex up to two synchronous or async terminals while allowing simultaneous X.25 operation for six or seven async terminals.

FEATURES SUMMARY AND DESCRIPTIONS

Table 1-2 summarizes the features of the 2600 Series XL PAD. In addition to the standard 2600 Series features, the XL PAD offers several features for X.25 operation of your async DTE equipment.

Chapter 2
Applications

Contents

Overview 2-1
Installation 2-2
Compatibility with 2600 Series Modems 2-2
EIA Interface Signals 2-3
Network Configurations 2-4
  Remote Host Concentration to an X.25 PSN 2-5
  Remote Terminal Concentration to an X.25 PSN 2-5
  Statistical Time Division Multiplexing (STDM) 2-7
  Remote Terminal Concentration to an X.25 Host 2-7
  TDM/X.25 Hybrid Network 2-8
  Multiple XL PAD Concentration with an Intelligent X.25 Processor (IXP) 2-8

OVERVIEW

A versatile tool for accessing packet switched networks with asynchronous data terminal equipment, the XL PAD can be used in a variety of applications to support your network requirements. This chapter will help you determine how to best use the PAD with your equipment and will give you information on XL PAD installation, EIA signal interfaces, and compatibility with other 2600 Series products, including other XL options.

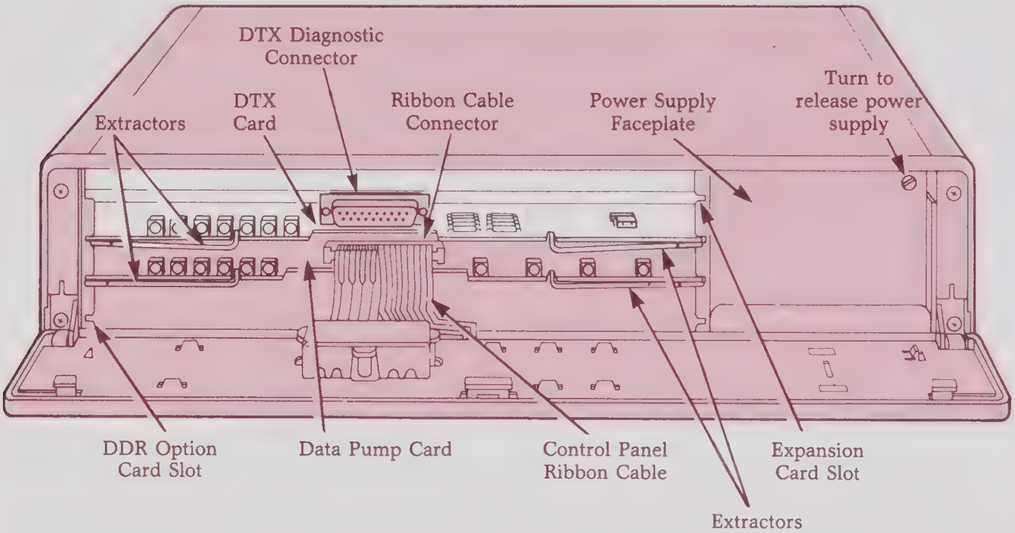


Figure 2-1. Front View with Control Panel Down

INSTALLATION

The site installation procedures for the XL PAD are the same as those described in the ''Installation & Troubleshooting'' section of the basic *2600 Series Modem User's Manual*. The XL PAD, however, comes with either four or eight terminal ports rather than the one-, four-, or six-port versions of basic 2600 Series Modems. Although additional ports are supplied with the XL PAD, the basic installation procedures and site requirements remain as described in the *2600 Series Modem User's Manual*. Unlike some other 2600 options, the XL PAD comes factory-installed in 2600 Series Modems and cannot be installed by the user in the field.

If you need to reseat or change PC (printed circuit) cards in the XL PAD, note that the XL PAD Option hardware is not located on a discrete PC card. Instead, the hardware for the XL PAD has been added to the DTE card supplied in basic 2600 Series Modems. With the addition of the XL PAD hardware, the DTE card has been renamed the DTX card. When you are reseating or replacing PC cards in the XL PAD, refer to the main manual instructions and consult Figure 2-1 for the location of the DTX card in the A-3 slot.

COMPATIBILITY WITH 2600 SERIES MODEMS

The XL PAD Option is available for the following modems used in point-to-point networks:

2680
2660
2640 (point-to-point operating modes only)
2620 (point-to-point operating modes only)

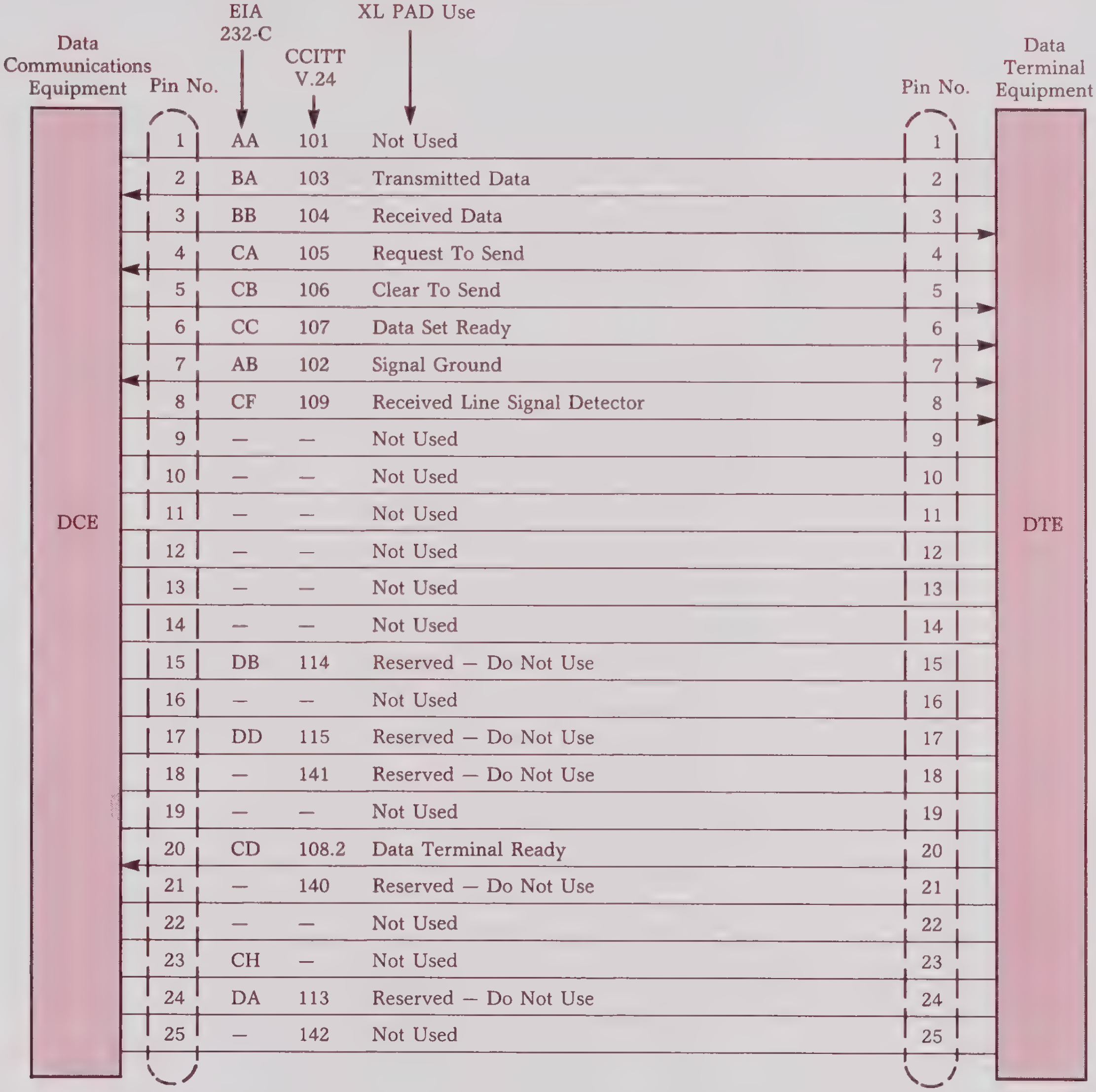
The XL PAD Option is also compatible with the following 2600 Series XL options with application restrictions as noted:

Dual Dial Restoral (DDR)
Enhanced Dual Dial Restoral (EDDR)
Communications Test Equipment (CTE) (Except RDS feature)

Other 2600 Series products that cannot currently be ordered with the XL PAD Option include the following:

2602	Two-modem nest
2608	Eight-modem nest
2630	Multipoint mux modem
2650	High-speed multipoint modem

If you have a 2600 Series Modem or option that has not been mentioned in this section, contact your Codex Customer Service Representative to determine compatibility with the XL PAD Option.



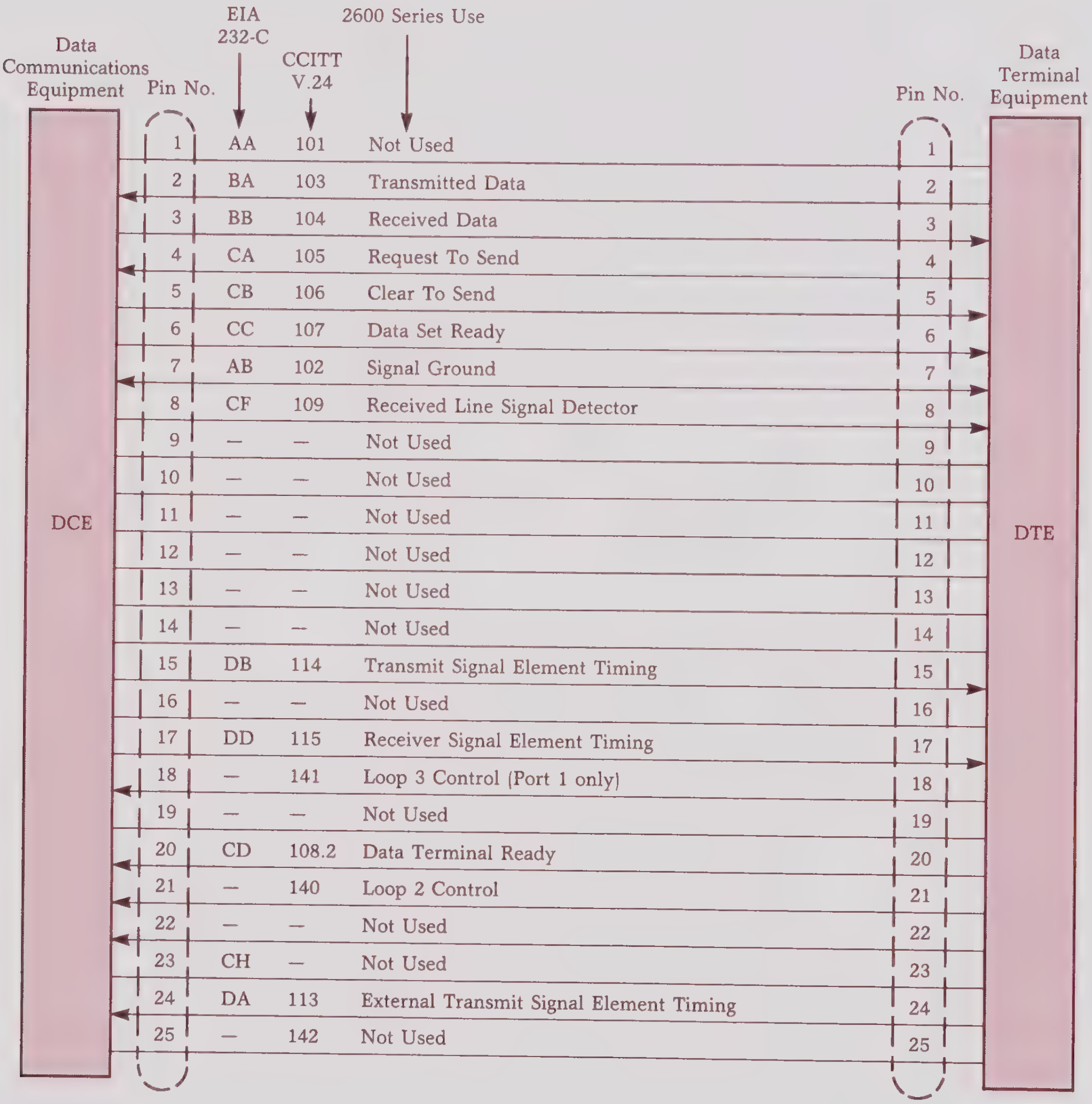
Data Communications Equipment Pin No.	EIA 232-C	CCITT V.24	XL PAD Use	Data Terminal Equipment Pin No.
1	AA	101	Not Used	1
2	BA	103	Transmitted Data	2
3	BB	104	Received Data	3
4	CA	105	Request To Send	4
5	CB	106	Clear To Send	5
6	CC	107	Data Set Ready	6
7	AB	102	Signal Ground	7
8	CF	109	Received Line Signal Detector	8
9	—	—	Not Used	9
10	—	—	Not Used	10
11	—	—	Not Used	11
12	—	—	Not Used	12
13	—	—	Not Used	13
14	—	—	Not Used	14
15	DB	114	Reserved — Do Not Use	15
16	—	—	Not Used	16
17	DD	115	Reserved — Do Not Use	17
18	—	141	Reserved — Do Not Use	18
19	—	—	Not Used	19
20	CD	108.2	Data Terminal Ready	20
21	—	140	Reserved — Do Not Use	21
22	—	—	Not Used	22
23	CH	—	Not Used	23
24	DA	113	Reserved — Do Not Use	24
25	—	142	Not Used	25

Figure 2-2. XL PAD to Data Terminal Interface for X.25 PAD Operation on Ports 1-8

EIA INTERFACE SIGNALS

Electrical connections for the XL PAD are the same as those in standard 2600 Series Modems, with the exception of EIA signals that are not used or have been reserved for the internal operation of the XL PAD. Terminal port connections in the XL PAD have different interface signals depending on whether you are using a port for TDM or X.25 PAD operation. In addition, the interface for a DCE-DCE tail circuit has been modified in the XL PAD.

Consult Figures 2-2 through 2-4 for the new XL PAD to DTE and XL PAD to DCE interface signals. For further information on EIA voltage levels, network management systems interface signals, and EIA signal descriptions, consult the "Installation & Troubleshooting" section of the *2600 Series Modem User's Manual.*



Pin No.	EIA 232-C	CCITT V.24	2600 Series Use
1	AA	101	Not Used
2	BA	103	Transmitted Data
3	BB	104	Received Data
4	CA	105	Request To Send
5	CB	106	Clear To Send
6	CC	107	Data Set Ready
7	AB	102	Signal Ground
8	CF	109	Received Line Signal Detector
9	—	—	Not Used
10	—	—	Not Used
11	—	—	Not Used
12	—	—	Not Used
13	—	—	Not Used
14	—	—	Not Used
15	DB	114	Transmit Signal Element Timing
16	—	—	Not Used
17	DD	115	Receiver Signal Element Timing
18	—	141	Loop 3 Control (Port 1 only)
19	—	—	Not Used
20	CD	108.2	Data Terminal Ready
21	—	140	Loop 2 Control
22	—	—	Not Used
23	CH	—	Not Used
24	DA	113	External Transmit Signal Element Timing
25	—	142	Not Used

Figure 2-3. Modem to Data Terminal Interface for TDM Operation on Ports 1 and/or 2

NETWORK CONFIGURATIONS

The XL PAD can be used in four basic X.25 network configurations to accommodate different types of hosts, terminals, and requirements. You can also configure up to two ports in any of the four network configurations for TDM operation, provided that 2600 Modems without the XL PAD have enough ports. The following sections describe the four types of X.25 network configurations you can construct with the XL PAD. A sample of a hybrid TDM/X.25 network is also described.

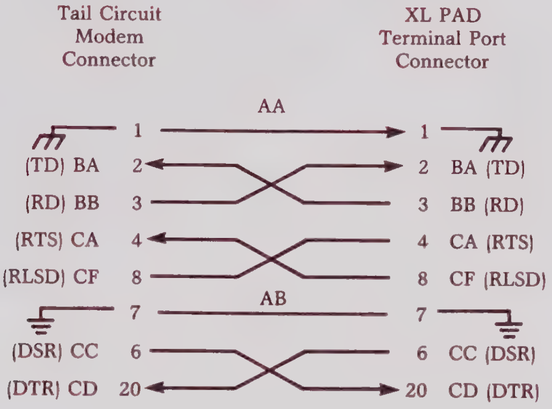

Tail Circuit Modem Connector
XL PAD Terminal Port Connector
AA
AB
1
(TD) BA 2
(RD) BB 3
(RTS) CA 4
(RLSD) CF 8
7
(DSR) CC 6
(DTR) CD 20
1
2 BA (TD)
3 BB (RD)
4 CA (RTS)
8 CF (RLSD)
7
6 CC (DSR)
20 CD (DTR)

Figure 2-4. XL PAD Terminal Port to Tail Circuit Modem Interface (Crossover Cable Required)

Remote Host Concentration to an X.25 Packet Switched Network

The XL PAD can be used to allow an asynchronous host computer that does not use the X.25 protocol (perhaps a minicomputer with async ports) to communicate remotely through a synchronous X.25 packet switched network (PSN). Data from up to eight host ports is assembled into packets; the packets in turn are inserted into frames for forwarding into the PSN. The data is then transmitted to a compatible 2600 Modem (without the XL PAD) and into the PSN through a single digital connection. See Figure 2-5 for an illustration of this type of network.

Remote Terminal Concentration to an X.25 PSN

In an example similar to the application shown in Figure 2-5, the XL PAD can be used to allow up to eight asynchronous terminals to communicate remotely through an X.25 PSN. See Figure 2-6 for an example of this application.

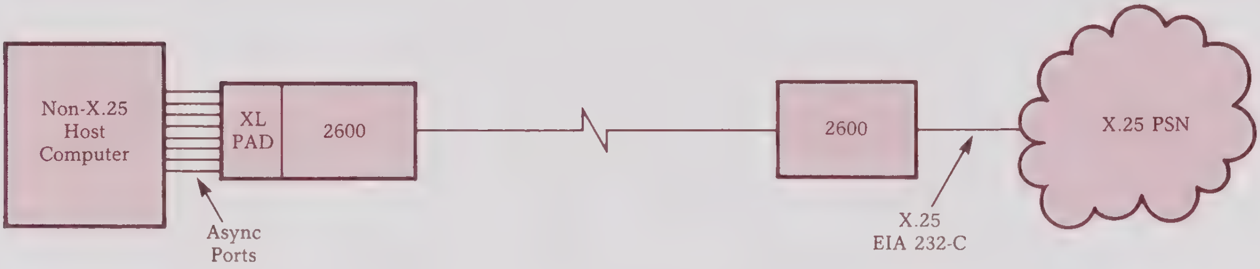

Non-X.25
Host
Computer
XL
PAD
2600
Async
Ports
2600
X.25
EIA 232-C
X.25 PSN

Figure 2-5. Remote Host Concentration to an X.25 PSN

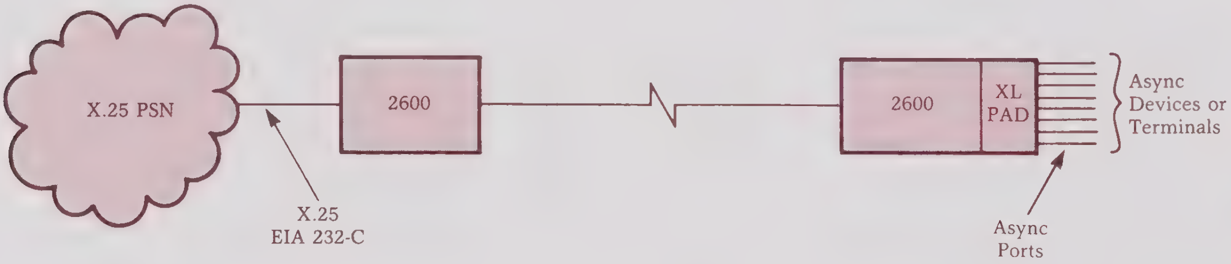

X.25 PSN
X.25
EIA 232-C
2600
2600
XL
PAD
Async
Devices or
Terminals
Async
Ports

Figure 2-6. Remote Terminal Concentration to an X.25 PSN

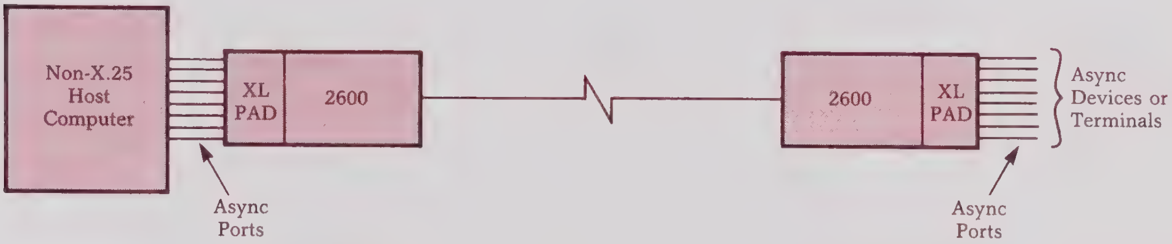

Non-X.25
Host
Computer
XL
PAD
2600
2600
XL
PAD
Async
Devices or
Terminals
Async
Ports
Async
Ports

Figure 2-7. STDM Operation

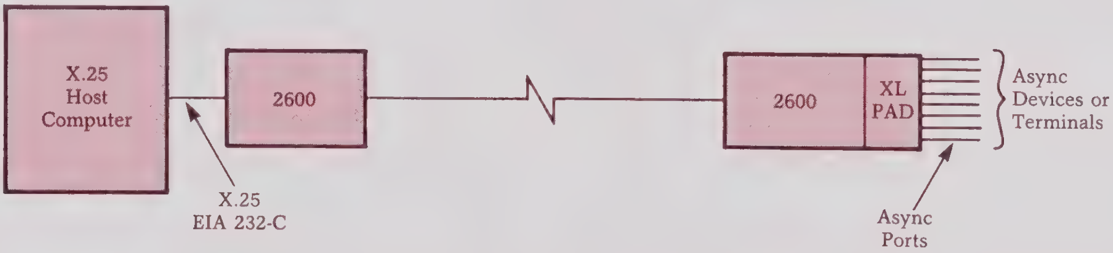

X.25
Host
Computer
2600
X.25
EIA 232-C
2600
XL
PAD
Async
Devices or
Terminals
Async
Ports

Figure 2-8. Remote Terminal Concentration to an X.25 Host

Statistical Time Division Multiplexing

The network shown in Figure 2-7 shows how XL PADs can be used as statistical multiplexers. This type of network provides error checking and increases efficiency when terminals are used infrequently. The following prerequisites will provide the best throughput when you have configured your network for statistical time division multiplexing (STDM) with the XL PAD:

- Disable character echoing and other error checking methods in the host computer. Error checking is provided by the X.25 protocol.
- Configure each XL PAD for local character echoing so that echoed characters are not transmitted over the network. The X.25 protocol provides error checking in both directions over the network, so remote character echoing for error detection is not necessary.
- Enable Auto Call (see Chapter 3) for each terminal port, if possible, to avoid unnecessary call establishment procedures at the beginning of each session with the remote end.

Remote Terminal Concentration to an X.25 Host

Use the network shown in Figure 2-8 to provide access to X.25 hosts from remote async terminals. This application is similar to the previous STDM example, but combines an X.25-compatible host and remote async terminals in a private packet switched network.

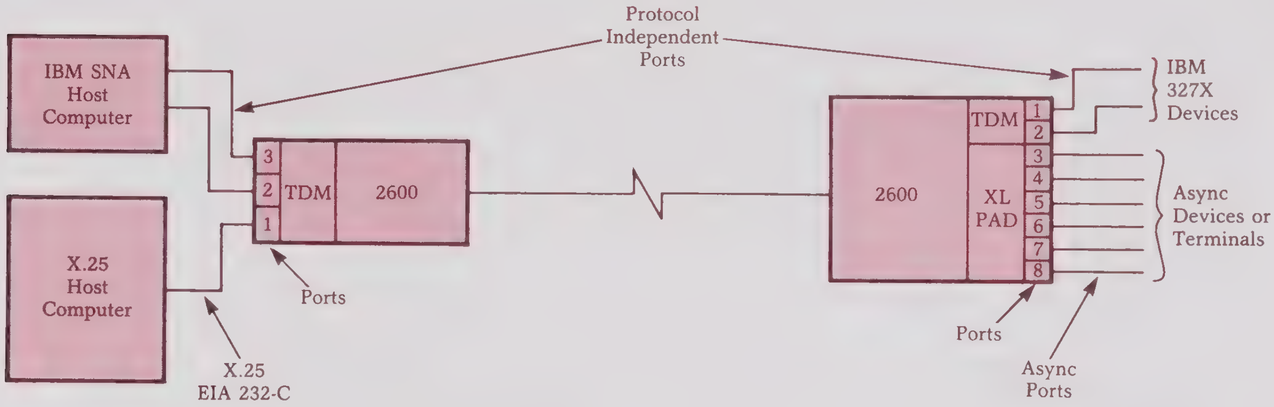

Protocol
Independent
Ports
IBM SNA
Host
Computer
X.25
Host
Computer
3
2
1
TDM
2600
Ports
X.25
EIA 232-C
2600
TDM
XL
PAD
1
2
3
4
5
6
7
8
IBM
327X
Devices
Async
Devices or
Terminals
Ports
Async
Ports

Figure 2-9. TDM/X.25 Hybrid Network

Time Division Multiplexing/X.25 Hybrid Network

While the XL PAD option is used primarily to provide X.25 communications for up to eight async ports, time division multiplexing (TDM) is offered on a maximum of two ports. An advantage of time division multiplexing is that it is protocol-insensitive, and therefore can be used to handle any unusual protocols. Packet assembly/disassembly has more overhead (address and control bits) than standard TDM operation, so it may be more efficient to time division multiplex one or two terminals for high-speed file transfers or similar applications.

You can also use TDM for one or two independent applications that do not require the packet assembly/disassembly functions of the modem/XL PAD. See Figure 2-9 for an example of a network with simultaneous TDM and X.25 communications. For a detailed explanation of how to select TDM for one or two ports, see Chapter 3.

Multiple XL PAD Concentration with an Intelligent X.25 Processor

You can configure larger X.25 networks by using multiple XL PADs and a Codex 6510 Intelligent X.25 Processor (IXP). The IXP is used to concentrate up to 27 remote XL PADs attached to a maximum of 216 terminals onto a single high-speed X.25 link to a host computer or X.25 PSN. See Figure 2-10 for a partial illustration of such a network.

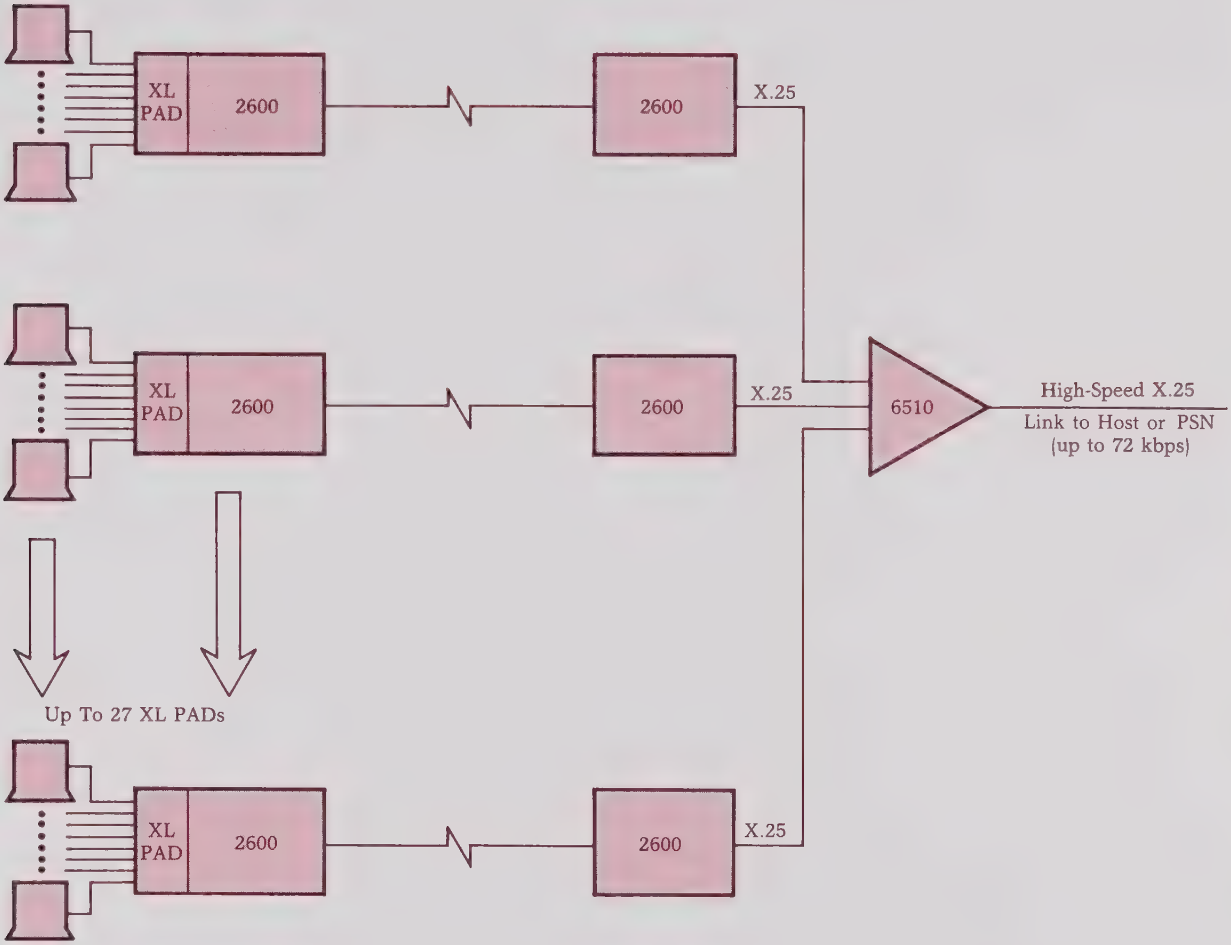

XL PAD
2600
2600
X.25
XL PAD
2600
2600
X.25
6510
High-Speed X.25
Link to Host or PSN
(up to 72 kbps)
Up To 27 XL PADs
XL PAD
2600
2600
X.25

Figure 2-10. Multiple XL PAD Concentration

Chapter 3
Initial Setup of PAD Parameters

Contents

General 3-1
Setting Modem Parameters 3-2
Using the Control Channel 3-4
Setup of XL PAD Parameters 3-6
  X.25 (Network Port) Parameters 3-8
  Async Port Parameters 3-12
  Control Channel 3-28
  Broadcast 3-30
  Auto Call Parameters 3-32

GENERAL

This chapter describes fundamental parameter settings for the 2600 Series Modem and its integral XL PAD option. You may wish to think of these settings as the parameters governing your everyday network operation. You will probably not be changing the settings described in this chapter frequently, even though they can be readily modified at any time.

You can configure two groups of parameters with the 2600 Series Modems equipped with the XL PAD option:

- Basic modem parameters.
- PAD-related parameters.

The basic modem parameters are configured through the modem front panel or Codex Network Management System as described in the *2600 Series Modem User's Manual*. The XL PAD and X.25 parameters are configured using a menu format that the PAD will generate to any async terminal within your network. You can access the XL PAD configuration menus by placing a virtual call from any async terminal connected to the local XL PAD, or by placing a virtual call from a terminal elsewhere in the network. The procedure for placing a virtual call with a preassigned address will be described later in this chapter and referred to in Chapters 5 and 6.

SETTING MODEM PARAMETERS

Configuring basic modem functions for a 2600 Series Modem with the XL PAD is similar to the configuration procedures outlined in the *2600 Series Modem User's Manual*. If you have not already done so, please read the basic manual to familiarize yourself with modem configuration.

Standard 2600 Series Modem parameters remain the same in the XL PAD option, *with the following exceptions:*

- When you enter the CLR CFM subcategory in the MODEM✳ category of the Configuration Tree, the factory modem parameter settings are loaded into the modem's configuration memory. The CLR CFM loads the modem defaults and causes the PAD to reload its defaults. Then the CLR CFM executes a PAD reboot so that the PAD defaults become active. The modem defaults become active automatically.
- Only mux channels 1, 2, and 3 are active in the XL PAD option.
- Because port-to-channel assignments are fixed, the port-to-channel mapping subcategory has been deleted from the Configuration Tree. All terminal ports selected for X.25 operation are routed over mux channel 1, while mux channels 2 and 3 are reserved for TDM operation on ports 1 and 2, respectively.
- The MSU feature is no longer available due to the deletion of the port-to-channel subcategory.
- Multipoint operating modes and tests are not available. In addition, fallback via CH control is not available, even if you are only using one or two ports for TDM operation.

When you choose a mux mode for your application, remember that only mux channels 1 through 3 are active and that they have fixed port assignments. Although you may select a mux mode that allocates part of the bandwidth to channels 4 through 8, you will be wasting some of the bandwidth you could have assigned to active ports. If you want to use eight async terminals for X.25 data transmission, the entire main channel (network port) rate should be assigned to mux channel 1. Select mux modes that have rate allocations for mux channels 2 and/or 3 when you want to use TDM for up to two terminals. Any mux mode that allocates a data rate to mux channels 2 and/or 3 will automatically select standard TDM operation for terminals connected to ports 1 and/or 2, respectively. The PAD is automatically rebooted to disable port 1 and/or 2 from the PAD when it is selected and deselected as a TDM port.

The following section outlines the changes you see from the front panel in the different configurations.

Local (2600 XL PAD) and Remote (2600 XL PAD-to-2600 XL PAD) Front Panel Operation

- OP MODE. All standard 2600 Series op modes are displayed while scrolling through the OP MODE subcategory, even though the 2600 XL PAD does not support multipoint modes. If you enter a multipoint mode, MODE N/A is displayed and the op mode is not changed.
- MUX MOD. You may select all standard 2600 Series mux modes from the MUX MOD subcategory. Some of the standard mux modes do not allocate full bandwidth to the first three channels, so they do not use the full main channel capability. Sometimes you select a mux mode that either allocates or deallocates bandwidth to port 1 or 2 (modem channel 2 or 3). If this occurs, the PAD automatically performs a reboot to reconfigure itself. This clears all virtual circuits and reactivates all PAD ports. You should perform mux mode changes only when you are reconfiguring the network.
- PORT/CH. The PORT/CH subcategory is eliminated because the 2600 XL PAD has a fixed port/channel map, which is as follows:

  modem channel 1 — network port
  modem channel 2 — TDM port 1
  modem channel 3 — TDM port 2

TDM operation is enabled on ports 1 and 2 only if bandwidth is allocated to the corresponding channel. If TDM is not enabled, the ports become PAD ports.

- TIMING. Modem timing choices are limited to INTERNAL, LOOPBACK, PORT 1, and PORT 2. Modem timing from port 1 or port 2 is valid only if bandwidth is allocated to the corresponding modem channel.
- STRP 01. Selecting switched carrier operation by setting bit 0 of STRP 01 does not enable switched carrier in the 2600 XL PAD because the carrier has to sustain the X.25 protocol.
- CLR CFM. Selecting CLR CFM forces the modem to reload and activate its default parameters, and allows the XL PAD to reload and activate its factory default parameters.

Remote (2600 XL PAD-to-2600) Front Panel Operation

- OP MODE. All standard 2600 Series op modes are displayed while scrolling through the OP MODE subcategory, even though the 2600 XL PAD does not support multipoint modes. If you enter a multipoint mode, MODE N/A is displayed and the op mode does not change.
- MUX MOD. You can select all standard 2600 Series mux modes from the MUX MOD subcategory. Some standard mux modes do not allocate full bandwidth to the first three channels, so they do not use the entire main channel capability.
- PORT/CH. The PORT/CH subcategory is displayed, and the 2600 port/channel map can be configured. You must configure it with one-to-one port/channel map for correct operation.
- TIMING. Modem timing choices include all ports on the 2600.
- STRP 01. Do not enable the switched carrier operation. The carrier is required to sustain the X.25 protocol.

Remote (2600-to-2600 XL PAD) Front Panel Operation

- OP MODE. You may select all standard 2600 Series op modes from the OP MODE subcategory. If the 2600 attempts to change the 2600 XL PAD's op mode to a multipoint mode, the 2600 XL PAD acknowledges the attempt, but does not act on it.
- MUX MOD. You can select all standard 2600 Series mux modes from the MUX MOD subcategory. Some mux modes do not allocate full bandwidth to the first three channels, and therefore do not use the entire main channel capability. Sometimes you may select a mux mode that either allocates or deallocates bandwidth to port 1 or 2 (modem channels 2 or 3). If this occurs, the PAD performs an automatic reboot to allow the XL PAD to reconfigure itself. This clears all virtual circuits and reactivates all PAD ports. You should perform mux mode changes only when reconfiguring the network.
- PORT/CH. The PORT/CH subcategory is displayed, and the 2600 XL PAD port/channel map is reported as 2 3 1 0. You cannot change the 2600 XL PAD port/channel map. If you attempt to change it from the 2600, the 2600 XL PAD acknowledges the attempt, but does not act on it.
- TIMING. Modem timing choices are INTERNAL, LOOPBACK, PORT 1, PORT 2, PORT 3, and PORT 4. For the 2600 XL PAD, you may select PORT 1 and PORT 2 timing, but not PORT 3 or PORT 4.
- STRP 01. Selecting switched carrier operation by setting bit 0 of STRP 01 does not enable switched carrier in the 2600 XL PAD because the carrier must sustain the X.25 protocol.

USING THE CONTROL CHANNEL

The XL PAD has internal channels that are separate and different from the mux channels in the 2600 Series Modems. In the case of the PAD, the term ''channel'' refers to an X.25 virtual circuit as described in Chapter 1.

One configurable address has been specially designated as a control channel for configuring the XL PAD. To access this control channel *locally*, you must place a virtual call to the local control channel address from an async terminal you have selected for X.25 operation and connected to any terminal port. You will not be able to access the control channel locally from terminal ports 1 and/or 2, however, if you have allocated bandwidth to mux channels 2 and/or 3, as this is the method used to select standard TDM operation for those ports.

To access the PAD control channel from a *remote* location, you must initiate a virtual call by entering the address of the remote PAD control channel you are trying to access. ■ **Note:** If you are accessing the control channel from a Codex 6510 IXP, first reconfigure the IXP's control channel by enabling the PAD mode and data forwarding on every character. This configuration change to the IXP provides the best setting for communications between the 6510 IXP and XL PAD control channels. You need to enter it only once prior to bringing up your X.25 network.

Once you have configured all modem parameters through the modem front panel or the Codex Network Management System, you can set up your async terminal(s) for X.25 operation through the XL PAD control channel. To configure the PAD, you will have to place a virtual call to access the PAD control channel using the factory default address and password settings. Once you have called the PAD, you will be able to change the control channel address and configuration.

To begin configuring the XL PAD, use an async CRT terminal to place a local virtual call to the PAD control channel by performing the following steps:

1) Power up both the modem and an async terminal you have selected for X.25 PAD operation. Following power-up, the modem and XL PAD self tests are run, as indicated by the TESTING and INIT_DTX displays on the modem front panel. The modem and the XL PAD are initialized when the modem operating mode is displayed on the front panel. It may take up to one minute for the operating mode to appear. If the XL PAD has just been installed in place of the DTE card, then ''RELOAD*'' is displayed to indicate the initial load of the XL PAD parameters. Once the operating mode is displayed, proceed to the next step.

2) Key in several carriage return characters ⟨CR⟩ on the terminal. A banner tells you which async port your terminal is connected to and the baud rate for that port. The banner is followed by an asterisk (*) that appears on the screen to prompt your response:

```
GCOM PAD v2.0: ASYNC PORT #3, 9600 BAUD
*
```

3) When the * appears, key in PROF CRT ⟨CR⟩ to permit efficient communications between your async CRT terminal and the XL PAD. The XL PAD returns the asterisk character again to confirm your input. The PROF CRT entry permits more efficient XL PAD to terminal communications with most types of async CRT terminals. If the asterisk is not displayed on your screen, or you have difficulty establishing a virtual circuit with the control channel, key in PROF DEFAULT ⟨CR⟩ rather than PROF CRT ⟨CR⟩. ■ **Note:** A banner is displayed if X.3 parameter 6 is selected for OTHERS, and the asterisk (*) is displayed if X.3 parameter 6 is selected for PROMPT. These can be combined using the plus character (+), for example, OTHERS + PROMPT.

4) When the * appears again, key in CALL 89 ⟨CR⟩ or CALL CTP ⟨CR⟩ on the terminal to place a virtual call to the control channel. The number 89 is the default address of the control channel, and the letters CTP are the mnemonic address of the control channel. (If you want to configure a remote XL PAD, substitute the remote PAD control channel address for 89 or CTP in the preceding instructions.) When you have connected to the control channel, the following information appears on the terminal screen:

```
OUTGOING CALL TO:        89

*

CALL CONNECTED, YOU CAN NOW SEND AND RE-
CEIVE DATA
Gcom Pad Control Channel
Login:
```

5) In response to the Login prompt, key in the control channel/modem password 5215 ⟨CR⟩. (If local or remote modem passwords are disabled, no control channel password is required and the Login prompt is not displayed.) The control channel password is always the same as the modem password, and can only be changed by a Codex Network Management System. When you access the control channel of a remote XL PAD, you must enter the password of the remote control channel if the Login prompt is displayed. Whether you are accessing the local or a remote control channel, the password will not be displayed (for security reasons) when you key it in. Once you key in the password, (or if the modem password is disabled) the PAD CONFIGURATION MAIN MENU appears.

An additional banner, ***EXPANDED MENUS***, appears when you select option 6. The Expanded Menus selection provides you with the same menus as the PAD CONFIGURATION MAIN MENU, but allows you access to additional parameters. These additional parameters offer greater flexibility in configuring the XL PAD in most networks.

```
***PAD CONFIGURATION MAIN MENU (1)***

1) Set parameters
2) Examine statistics
3) Get statistics
4) Diagnostics
5) Restart menu
6〉 Expanded Menus
7〉 Exit configuration
Enter number:
```

Index numbers in the PAD CONFIGURATION MAIN MENU and all XL PAD menus are immediately followed by the characters) or 〉. When the) character is used, as in selection 1) above, the) character indicates that the menu selection leads to other submenus. When 〉 follows the menu index number, the selection may lead to parameter settings or action, but *not* to other menus.

You can use the XL PAD control channel to set parameters and to monitor various status and performance information. To perform your initial setup of the XL PAD, key in 1 ⟨CR⟩ to access the SET PARAMETERS menu.

SETUP OF XL PAD PARAMETERS

Once you have completed Steps 1 through 5 described in the previous section, the SET PARAMETERS menu will be displayed.

```
SET PARAMETERS (1.1)
1) X.25 parameters
2) Async port parameters
3) Control channel
4) Broadcast
5) Auto call
Enter number (X to exit):
```

The menu choices give you access to async port and X.25 network port parameters, as well as control channel, broadcast, and auto call parameters. Note that any time after you enter one of the SET PARAMETERS (or any other control channel) selection(s), you may key in any of the following characters to move between parameters or menus:

- **⟨CR⟩.** Key in this character after changing a parameter to terminate your entry for a parameter. If you do not want to make any changes to the setting displayed in brackets, key in ⟨CR⟩ (and another data forwarding character, if you select one) to skip to the next parameter.

  You must terminate every entry you make with ⟨CR⟩. If you select a data forwarding character that is different from the factory default ⟨CR⟩, you must enter both characters to forward data to the XL PAD. For example, if you select ⟨LF⟩ as the data forwarding character, you must enter ⟨CR⟩ before the data forwarding character ⟨LF⟩ to terminate the entry and ⟨LF⟩ to forward the data on your terminal to the XL PAD. *In the instructions that follow, when the word "enter" is used in relation to a parameter you must key in ⟨CR⟩ (and another data forwarding character if you select one) to terminate the entry and send the data on your terminal to the XL PAD.*

- **[ ].** The value in brackets will remain in effect and the previous parameter will be redisplayed.

- **X.** Redisplays the previous menu if you have not made any parameter changes. If you have made changes, the following options are displayed:

  ```
  Parameters have been changed. Do you want to:
  1) Exit and not make changes effective
  2) Exit and make changes effective
  3) Go back through the menu
  Enter number:
  ```

- **?.** Prints help text on the screen to aid you in setting parameters.

These special characters will enable you to selectively change parameter settings, receive explanations of prompts, redisplay the previous prompt, or move from lower-level to higher-level menus.

When you want to change the value on a parameter, enter a decimal or hex number. If a parameter selection is a range specified in decimal then you may also enter the value in its hexidecimal equivalent by entering 0xhh.

Notice that all of the parameters displayed on your screen have a value contained in brackets ([ ]). The values you see at initial startup are the factory default settings. When you are configuring X.3 parameters, the settings displayed in brackets are derived from a set of parameters called a "profile." If you followed the instructions for using the control channel described earlier in this chapter, you have already selected a profile titled "CRT," and the settings that make up this profile will appear in brackets when you access selections for the port you are using from the X.3 PARAMETER PROFILES menu (under the ASYNC PORT PARAMETERS menu).

When you request the on-line help text by entering a question mark (?), a list of valid parameter settings is displayed. Multiple options can be selected by entering options separated by the plus character (+). An ALL command is provided to simplify selecting all the options. When you use ALL, the value in brackets will be all the valid options separated by +. ALL is never displayed in the brackets as a value.

■ **Note:** Whenever a parameter is preceded by an asterisk (*), the setting you enter is not enabled until the next PAD reboot, system reboot, or power-cycle procedure. These reboot procedures load the parameter changes you have made into the configuration memory, thereby enabling the new parameter settings. This procedure is fully described in Chapter 4. Parameters that are not preceded by an asterisk take effect when you reach the end of a menu and enter selection 2 from the choices that are displayed as shown below:

```
Parameters have been changed. Do you want to:
1) Exit and not make changes effective
2) Exit and make changes effective
3) Go back through the menu
Enter number:
```

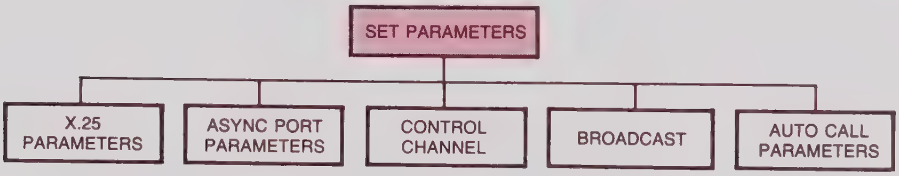
When you enter selection 2 to enable the changes you have made, a display similar to the following appears:

```
Parameters instated in running system
Writing to nonvolatile memory
++++++++.....
Write completed
```

The plus characters (+) move across your screen to indicate that your parameter changes are being loaded into the XL PAD's nonvolatile memory. When the loading is complete, the plus characters stop accumulating and the **Write completed** message is displayed, followed by the menu you selected to begin making your changes.

■ **Note:** Some parameter settings may clear the virtual call to the control channel when they are enabled. If this occurs and you need to perform further configurations with the control channel, you must place a virtual call to the control channel again as described in the beginning of this chapter.

When the SET PARAMETERS menu appears on the screen, you may perform the entire initial setup of the XL PAD. The following sections of this chapter describe the parameters in the order they are presented in the menus, but they can be configured in any order. If this is the first time you are setting XL PAD parameters, we suggest that you configure the following parameter groups in the order they are presented. Use the worksheets in Chapter 7 to write down your configurations. See the figure below for a description of the parameter groups that branch out from the SET PARAMETERS menu. From any parameter group, type X ⟨CR⟩ to return to the SET PARAMETERS menu.



X.25 (Network Port) Parameters

The Network Port parameters govern the link between a local modem/XL PAD and a remote X.25 device. Your parameter selections will determine the content of several packet and frame fields. See Table 3-1 for a list of the X.25 Parameters and their default settings. To access the X.25 PARAMETERS menu, consult the illustration below:

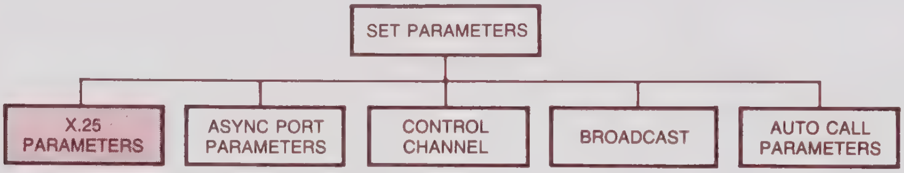


Table 3-1.
X.25 (Network Port) Parameters

X.25 Parameter	*Valid Entries*	*Default*
PAD Calling Address	(Any 15 numerals)	0
Calling Address Insertion	ENaBle or DISable	DIS
Default Packet Size	128, 256, 512	128
*Lowest SVC Number	0 to 4095	1
*Highest SVC Number	0 to 4095	11
*DTE/DCE	DTE or DCE	DTE
Expanded Menus Only:		
*Frame Level Window Size	1 to 7	7
*T1 Timer	1 to 53	3
*N2 Timeouts	1 to 255	20
*Maximum Packet Size	128, 256, 512	512
Default Packet Window Size	1 to 7	2
Clear Request Has Diagnostic	DIAG or NODIAG	DIAG
Reset Request Has Diagnostic	DIAG or NODIAG	DIAG
Restart Request Has Diagnostic	DIAG or NODIAG	DIAG
Packet Level Options	NPWS, NOCNFOK, NORSTRT, ALL, NONE	NOCNFOK
*Frame Level Options	DISC, SABM, ALL, NONE	DISC+SABM
Restart Timer	0 to 255	18
Restart Retries	0 to 255	255
Call Request Timer	0 to 255	6
Reset Request Timer	0 to 255	18
Reset Retries	0 to 255	1
Clear Request Timer	0 to 255	18
Clear Request Retries	0 to 255	1
Minimum Negotiated Packet Size	PS_64, PS_128, PS_256, PS_512	PS_128

PAD Calling Address. An X.25 network usually sees the XL PAD as a DTE. (Because the PAD is transparent to the network, an XL PAD port can have a unique address.) The remote X.25 device or remote XL PAD that receives a call request packet containing this address knows what connection point in the network the packet was sent from. The PAD calling (network) address can be from 1 to 15 digits long. Do not use wild-card characters (?,*).

Calling Address Insertion. If you want the XL PAD's calling address inserted in outgoing call request packets, enter ENB. If not, enter DIS. In most cases, the calling address will not be required.

Default Packet Size. This parameter specifies the maximum number of bytes you want inserted in the user data field of each outgoing packet. Your choice will be invoked if the facilities field of an outgoing call request packet does not specify the packet size. The valid default packet size selections are 128, 256, or 512 bytes per packet. ■ **Note:** Default Packet Size requires that NPWS (Negotiate Packet Window Size) be selected for Packet Level Options and that the packet size for facilities negotiation has not been defined by the user (refer to PAD command(s) facility).

***Lowest SVC Number.** Enter the lowest Switched Virtual Circuit (SVC) number you will be using to route calls through the XL PAD. This parameter is the same as your lowest Logical Channel Number (LCN) for placing or receiving calls. Valid entries range from 1 to 4095. Note that a total of only 32 SVCs are available for the XL PAD: the Highest SVC Number minus the Lowest SVC Number must be 32 or less. *Do not set SVC to 0 (zero) or you will disable the SVC operation.*

The asterisk preceding this parameter indicates that the parameter is not enabled until the next PAD reboot, system reboot, or power cycle.

■ **Note:** LCN 0 is usually reserved for network diagnostics in X.25 networks and is not available to transmit user data. The XL PAD will accept settings of 0 for the lowest and highest SVC numbers, however, this setting tells the XL PAD no SVCs are desired and will prevent you from placing virtual calls from the XL PAD.

***Highest SVC Number.** Enter the highest Switched Virtual Circuit (SVC) number you will be using to route calls through the XL PAD. This parameter is the same as your highest LCN for placing or receiving calls. Valid entries range from 1 to 4095. Note that only 32 SVCs are available for the XL PAD: the Highest SVC Number minus the Lowest SVC Number must be 32 or less.

The asterisk preceding this parameter indicates that the parameter is not enabled until the next PAD reboot, system reboot, or power cycle.

■ **Note:** LCN 0 is usually reserved for network diagnostics in X.25 networks and is not available to transmit user data. The XL PAD will accept settings of 0 for the lowest and highest SVC numbers, however, this setting tells the XL PAD no SVCs are desired and will prevent you from placing virtual calls from the XL PAD.

***DTE/DCE.** This parameter determines whether the modem/XL PAD will logically act as an X.25 DTE or DCE in relation to the network. The parameter also determines the frame level network address of A (DTE or bit code 03) or B (DCE or bit code 01). For all the applications described in Chapter 2, except the STDM network, the modem/XL PAD should have a DTE/DCE setting of DTE. If you have set up two XL PADs for STDM as described in Chapter 2, one XL PAD must have a setting of DTE and the other must have a setting of DCE. You can also select DCE as the local XL PAD setting if the remote device connected to the network port can only be configured as a DTE.

The asterisk preceding this parameter indicates that the parameter is not enabled until the next PAD reboot, system reboot, or power cycle.

X.25 Parameters — Expanded Menus Only

***Frame Level Window Size.** Use this parameter to select the number of outstanding information frames the XL PAD will be allowed to transmit to the network before an acknowledgment is required from the network or remote X.25 device. Choose the number of frames from the range of 1 to 7.

The asterisk preceding this parameter indicates that the parameter is not enabled until the next PAD reboot, system reboot, or power cycle.

***T1 Timer.** The T1 timer determines how long the XL PAD will wait for a confirmation that previously transmitted frames have been received before it begins error recovery procedures. Choose a setting from the range of 1 to 53 seconds, depending on the network recovery speed you want. Timer accuracy is ± 10 milliseconds.

The asterisk preceding this parameter indicates that the parameter is not enabled until the next PAD reboot, system reboot, or power cycle.

***N2 Timeouts.** Specifies the number of times the XL PAD will reset the T1 timer and try to prompt a confirmation from the network. When the N2 timeouts limit is reached, the XL PAD assumes the link is down and initiates link setup procedures. Enter the number of T1 expirations (from the range of 1 to 255) that will constitute an N2 timeout.

The asterisk preceding this parameter indicates that the parameter is not enabled until the next PAD reboot, system reboot, or power cycle.

***Maximum Packet Size.** This parameter limits the maximum packet size during packet size negotiation with the network DCE. The maximum packet size must always be equal to or greater than the Default Packet Size. Any attempt to enter a maximum packet size less than the default packet size causes the XL PAD to ignore your entries for both parameters and to load the default values. You can select a maximum packet size of 128, 256, or 512 bytes per packet.

The asterisk preceding this parameter indicates that the parameter is not enabled until the next PAD reboot, system reboot, or power cycle.

Default Packet Window Size. Specifies the number of user data packets that may be sent before an acknowledgment is required from the remote device. Enter the number of packets from the valid range of 1 to 7.

Clear Request Has Diagnostic. If you want the clear request packets to include the diagnostic field, enter DIAG. You should include the diagnostic field if there is a problem with the network. The diagnostic field can tell you a possible reason for the error. If you do not want to include the diagnostic field, enter NODIAG. (Refer to Table 7-5 for further diagnostic code information.)

Reset Request Has Diagnostic. If you want the reset request packets to include the diagnostic field, enter DIAG. The diagnostic field can tell you a possible reason for a network error. If you do not want to include the diagnostic field, enter NODIAG. (Refer to Table 7-5 for further diagnostic code information.)

Restart Request Has Diagnostic. If you want restart request packets to include the diagnostic field, enter DIAG. The diagnostic field can tell you a possible reason for a network error. If you do not want to include the diagnostic field, enter NODIAG. (Refer to Table 7-5 for further diagnostic code information.)

Packet Level Options. This parameter controls packet level initialization, packet size and window size negotiation during call setup, and handling of packet level timer expirations. All options except NONE may be combined by using +. For example, you may combine NPWS + NOCNFOK or NPWS + NOCNFOK + NORSTRT.

- NPWS (Negotiate Packet Size and Packet Window Size). This allows packet size and/or packet window size negotiation in the facilities field. If you do not select NPWS, packet size and packet window size are not allowed in the facilities field of outgoing call request packets, but they are allowed in incoming call request packets.

- NOCNFOK (No Confirmation OK). When you select NOCNFOK, the packet level for a logical channel enters the state it would have entered had it received an actual confirmation for a clear, reset, or restart packet sent to it. The packet level enters this state after timing out and the maximum number of retries for a particular packet type has been reached. If you do not select NOCNFOK, or the timer values are set to 0 (zero) for clear, reset, or restart timers, then the logical channel waits indefinitely for a confirmation.
- NORSTRT. The packet level will not issue a restart request packet upon initialization.
- ALL. Enables all of the above options.
- NONE.

***Frame Level Options.** This parameter controls how the data link is initialized. All options except ALL and NONE may be combined by using +.

- DISC (Disconnect). The PAD sends DISC to initialize the frame level.
- SABM (Set Asynchronous Balance Mode). The PAD sends SABM to initialize the frame level. Unacknowledged DISC frames are sent N2 times (see X.25 Parameter N2 Timeout), then SABM frames are sent if DISC + SABM is selected.
- ALL. Enables all of the above options.
- NONE.

The asterisk preceding this parameter indicates that the parameter is not enabled until the next PAD reboot, system reboot, or power cycle.

Restart Timer. The amount of time, measured in 10-second intervals, that the PAD waits before retransmitting a restart request packet. Choose the number of intervals from a range of 0 to 255. For example, a time setting of 18 equals 180 seconds. A setting of 0 causes the PAD to wait indefinitely. Timer accuracy is ± 10 milliseconds.

Restart Retries. The number of times a restart request is retransmitted before the PAD waits indefinitely for a response. This parameter is not effective if Packet Level Options has been set to NOCNFOK and the retry setting is 0, or if the Restart Timer is set to 0. Choose a setting from a range of 0 to 255. A setting of 0 sends one restart request. A setting of 1 sends two restart requests, because you retry once.

Call Request Timer. The amount of time, measured in 10-second intervals, that the PAD waits before clearing a call that has not been accepted. Choose the number of intervals from a range of 0 to 255. A setting of 0 causes the PAD to wait indefinitely. Timer accuracy is ± 10 milliseconds.

Reset Request Timer. The amount of time, measured in 10-second intervals, that the PAD waits before retransmitting a reset request packet. This parameter is not effective if Packet Level Options is set to NOCNFOK and the retry setting is 0, or if the Reset Request Timer is set to 0. Choose the number of intervals from a range of 0 to 255. A setting of 0 causes the PAD to wait indefinitely. Timer accuracy is ± 10 milliseconds.

Reset Retries. This parameter specifies the number of reset request transmissions the PAD will make before clearing the call. Choose a setting from a range of 0 to 255. A setting of 0 sends one reset request. A setting of 1 sends two reset requests, because you retry once.

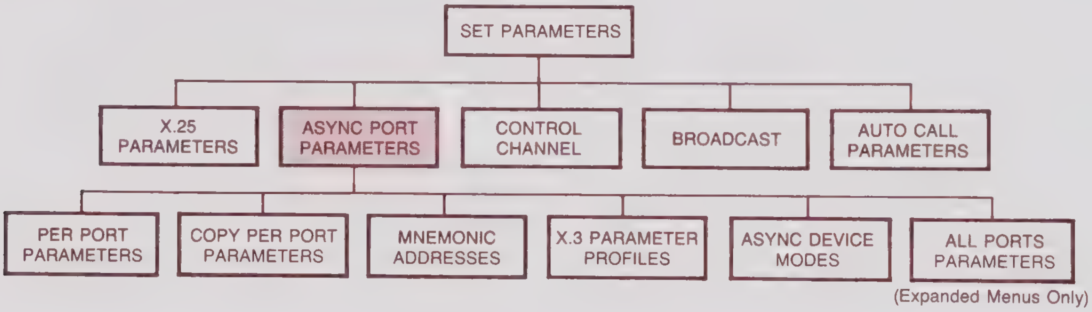
Clear Request Timer. The amount of time, in 10-second intervals, that the PAD waits before retransmitting a clear request packet. Choose the number of intervals from a range of 0 to 255. A setting of 0 causes the PAD to wait indefinitely. Timer accuracy is ± 10 milliseconds.

Clear Request Retries. Determines the number of clear request transmissions the PAD sends before waiting indefinitely for a response. This parameter is not meaningful if Packet Level Options is set to NOCNFOK and the retries setting is 0, or if the Clear Request Timer is set to 0. Choose from a range of 0 to 255. A setting of 0 sends one clear request. A setting of 1 sends two clear requests, because you retry once.

Minimum Negotiated Packet Size. This parameter specifies the minimum size allowed in packet size negotiations. It is recommended that you keep this parameter set at its factory default setting of PS_128.

Async Port Parameters

To access the ASYNC PORT PARAMETERS menu, go to the SET PARAMETERS menu and enter 2. The ASYNC PORT PARAMETERS menu consists of five Main Menus (or six Expanded Main Menus), which are described in the following text in the same order they are presented in the illustration:


SET PARAMETERS
X.25 PARAMETERS
ASYNC PORT PARAMETERS
CONTROL CHANNEL
BROADCAST
AUTO CALL PARAMETERS
PER PORT PARAMETERS
COPY PER PORT PARAMETERS
MNEMONIC ADDRESSES
X.3 PARAMETER PROFILES
ASYNC DEVICE MODES
ALL PORTS PARAMETERS
(Expanded Menus Only)

Per Port Parameters. Enter the number of the async port for which you want to configure parameters. The per port parameters are directly related to each async DTE you have attached to the modem/XL PAD, rather than to the configuration of the PAD through the X.3 parameters. There are two levels of interface. One is the physical level that the per port parameters control; the other level is a logical connection that the X.3 parameters control. Once you have selected all the parameters for the first async port, repeat the procedure for every port with an attached device or use the COPY PER PORT PARAMETERS menu. See Table 3-2 for a list of the per port parameters and their default settings. To access the PER PORT PARAMETERS menu see the illustration below:

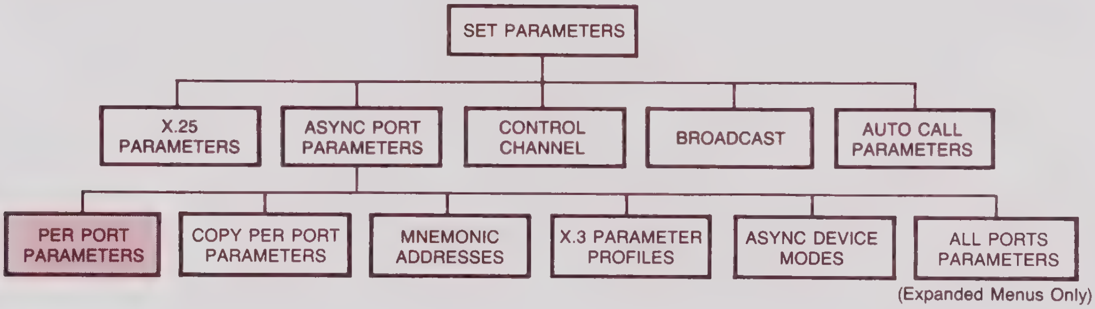

SET PARAMETERS
X.25 PARAMETERS
ASYNC PORT PARAMETERS
CONTROL CHANNEL
BROADCAST
AUTO CALL PARAMETERS
PER PORT PARAMETERS
COPY PER PORT PARAMETERS
MNEMONIC ADDRESSES
X.3 PARAMETER PROFILES
ASYNC DEVICE MODES
ALL PORTS PARAMETERS
(Expanded Menus Only)

Table 3-2.
Per Port Parameters

Per Port Parameter	*Valid Entries*	*Default*
Async Port Calling Address	1 to 15415 decimals/wild cards	*0*n*
Default Listen Type	NONE, ADDR, DATA	ADDR
Default Listen Pattern	1 to 15415 decimals with ADDR, 1 to 15412 ASCII characters with DATA	0*n*
Enable Auto Baud	ENB, DIS	ENB
Default Speed	B50, B75, B100, B110, B134_5, B150, B200, B300, B600, B1200, B1800, B2400, B4800, B9600, B19200	B9600
Enable Auto Parity	ENB, DIS	DIS
Parity Type	NO_8, EVEN_7, ODD_7, NO_7	NO_8
Highest X.3 Parameter Read by Remote DTE	UPTO_80, UPTO_84	UPTO_84
Expanded Menus Only:		
Stop Bits	0 (2 bits/char at or below 110 baud, 1 bit/char above 110 baud) 1 (1 bit/char) 2 (2 bits/char) 3 (1.5 bits/char)	0
I/O Mode	NO EOL, NONE	NONE
X.28 Per Port Options	RCMDS, NONE	NONE
Maximum Output Buffers to Queue at Async Interface	1 to 10	4
XON Hysteresis	0 to 50	4
Data Restraint Output Signal	DTR, RTS, NONE	RTS
Type of Data Restraint Output	XONXOFF, SIGNAL, ALL, NONE	XONXOFF
Data Restraint Input Signal	DSR, DCD, CTS, NONE	CTS
Type of Data Restraint Input	XONXOFF, SIGNAL, ALL, NONE	XONXOFF
Bell Character	0 to 255	7
XOFF Character	0 to 255	19
XON Character	0 to 255	17
Asserted Connection Signal	DSR, DCD, CTS, ALL, NONE	DSR+DCD+CTS
Sensed Connection Signal	DTR, RTS, ALL, NONE	DTR+RTS
Asserted Invitation to Connect Signal	DSR, DCD, CTS, ALL, NONE	NONE
Sensed Invitation to Connect Signal	DTR, RTS, ALL, NONE	NONE
All Incoming Signals Must Be Active	CONALL, ITCALL, ALL, NONE	NONE
Disconnect Wait Timer Interval	0 to 65,535	0

■ **Note:** For *O*n* (in Async Port Calling Address and Default Listen Pattern) the *n* is the port number for the default values.

(continued on next page)

Table 3-2 (continued).
Per Port Parameters

Per Port Parameter	*Valid Entries*	*Default*
Connection Timer Interval	0 to 65,535	0
Asserted Connection Signal Options	CTRL, NONE	NONE
When to Raise Asserted Connection Signal to Initiate Connection	DITC, ICALL, ACTV, ALL, NONE	NONE
When to Drop the Asserted Connection Signal to Initiate Disconnection	RCLR, ICLR, UCLR, EXPVCE, ALL, NONE	NONE
When to Respond to the Sensed Connection Signal	UPWT, DNWT, UPRSP, DNRSP, ALL, NONE	UPWT+DNRSP
When to Pulse the Asserted Invitation to Connect Signal	X25UP, ICALL, ACTV, ALL, NONE	NONE
Sensed Handshake Signal	DTR, RTS, ALL, NONE	NONE
Asserted Handshake Signal	DSR, DCD, CTS, ALL, NONE	NONE

Enter 1 from the ASYNC PORT PARAMETERS menu to select the PER PORT PARAMETERS menu. A list of active ports is displayed. Select one from the list. ■ **Note:** The XL PAD is available in 4- or 8-port configurations, which the active port list reflects. Port 1 and/or 2 do not appear if selected for TDM.

- ***Async Port Calling Address.*** This address is similar to the PAD calling address described under the X.25 PARAMETERS menu, except that it identifies your local async port to the X.25 device on the remote end. The async port address is actually a subaddress that is appended to the PAD calling address to identify which XL PAD and async port a call request packet was sent from. The 1- to 15-digit address can be composed of any combination of numerals and wild-card characters (*, ?). When you enter a wild-card character in the async port address, the XL PAD substitutes characters from the PAD calling address in place of the wild-card characters. See Chapter 1 for a more detailed description of addressing in the XL PAD.

- ***Default Listen Type.*** Your entry determines which field of incoming call request packets the XL PAD will "listen" to for the called address that matches that of the selected port. Some networks will not allow you to enter a port subaddress in the called address field of call request packets. These networks usually require additional address information in the user data field of call request packets. For such networks, enter DATA. Enter ADDR if you want the PAD to examine the called address field of incoming packets for the listen address pattern (this is the usual and default setting). If you do not want the PAD to use a default listen address, enter NONE. If you do not use the listen command as described in Chapter 5, the default listen type goes into effect.

- ***Default Listen Pattern.*** To define the default listen pattern, enter up to 12 characters if the default listen type is DATA. The characters may be all upper-case, all lower-case, or mixed. Enter up to 15 numerals if the default listen type is ADDR. Only call request packets that have a called address or user data matching the listen pattern will be relayed by the PAD to the corresponding async port. When you do not specify a listen address in the command mode, the default listen pattern will be in effect. ■ **Note:** When the default listen type is ADDR, the called address of incoming call request packets cannot match the default listen pattern if the default listen pattern contains any non-numeric characters. The listen pattern can also be configured from the user terminal using XL PAD commands. To enable Default Listen Pattern when the port is already actively communicating in data or command mode, you must restart or reboot the port, reboot the system, or power cycle the PAD.

- ***Enable Auto Baud.*** Use this setting to select an async port data rate automatically. The XL PAD detects rates of 75, 150, 300, 600, 1200, 2400, 4800, and 9600 baud when this setting is enabled (ENB). If the async device connected to a port does not operate at one of the auto baud rates, or if you want this feature disabled for any reason, enter DIS.

- ***Default Speed.*** Use this parameter to determine the default rate of an async port when auto baud is disabled. Available rates are: B50, B75, B100, B110, B134_5, B150, B200, B300, B600, B1200, B1800, B2400, B4800, B9600, and B19200.

- ***Enable Auto Parity.*** If you want the XL PAD to automatically detect the parity of the async device on the selected port, enter ENB. The PAD recognizes only odd or even parity. If the device uses a different type of parity or no parity, or you do not want to use the auto parity feature, enter DIS.

- ***Parity Type.*** If the Enable Auto Parity parameter is not enabled, use this parameter to specify the type of parity the attached device uses. The port can be configured for no parity with eight bits NO_8, for even parity with seven bits EVEN_7, for odd parity with seven bits ODD_7, or for no parity with seven bits NO_7. The parity type is overridden and ignored if auto parity is enabled. ■ **Note:** A Parity Type of NO_8 does not mean that data is transmitted transparently through the XL PAD. Select the CC_TSP permanent profile or set up a special user profile to send transparent data. This setting is subject to the X.3 parameter 21 setting.

- ***Highest X.3 Parameter Read by Remote DTE.*** This parameter determines which version of X.3 parameters are sent to the remote DTE when the remote DTE requests the values with an X.29 command. To accommodate remote DTEs that use the 1980 version of X.3, enter UPTO_80. For remote DTEs that use the 1984 version of X.3, enter UPTO_84.

Per Port Parameters — Expanded Menus Only

- ***Stop Bits.*** Enter the number of stop bits per character your async device is configured to receive. See the following for the available settings:

Setting	*Stop Bits/Character*
0	2 stop bits at and below 110 baud, 1 stop bit above 110 baud
1	1 stop bit
2	2 stop bits
3	1.5 stop bits

I/O Mode (Input/Output Mode). Setting the NO EOL (No End Of Line) option tells the PAD software not to check for input at the end of each output line. The PAD checks for input at the end of an mbit sequence only. An mbit sequence is used when a message is broken among two or more frames. The NONE option tells the PAD to check for input at the end of each output line and at the end of the user sequence.

X.28 Per Port Options. Use this parameter to enable or disable X.28 option for the port. RCMDS (Remote PAD Commands) enables remote PAD commands. (See chapter 5 for a list of additional command available when RDMDS is selected.) NONE disables any X.28 option at the X.28 interface.

Maximum Output Buffers to Queue at Async Interface. Use this parameter to determine the maximum number of output buffers to queue at the async interface. The parameter protects the PAD from running out of buffers because of tab expansion or linefeed insertion. Choose the number of output buffers you want from a range of 1 to 10.

XON Hysteresis. The PAD removes the flow control stop to the async device when the number of input buffers in use drops to the Low Input Buffer Level minus the XON Hysteresis setting. Choose the setting from the range of 0 to 50.

Data Restraint Output Signal. This parameter defines the EIA signal that functions as the flow control signal from the async device to the PAD if the EIA signal control is enabled. Choose one of the following signals: DTR, RTS, or NONE.

- ***Type of Data Restraint Output.*** Use this parameter to select the method the async device will use to control the flow of data from the XL PAD to the async device. Enter XONXOFF if you wish to use XON/XOFF characters generated by the device. Enter SIGNAL if you want to use the RTS (Request To Send) or DTR (Data Term Ready) EIA signal the device generates. You can also enter NONE if you do not want the async device to control data flow from the XL PAD to the async device. ■ **Note:** Entering NONE for the type of data restraint output will override any setting you make for X.3 parameter 12 (Flow Control of the PAD). Enter ALL to select all options except NONE without using +. In addition, if you enable X.3 parameter 12, the data restraint output settings of XONXOFF or SIGNAL are overridden if the three following conditions apply:
  - Local echoing from the PAD is enabled.
  - You continue to key in data after entering the XOFF character when the data restraint output setting is XONXOFF, or you continue to enter data after RTS or DTR is lowered when the data restraint output setting is SIGNAL.
  - A buffer overflow occurs, causing data to be echoed back to the terminal, thereby overriding the XOFF character or ignoring the RTS signal.

Data Restraint Input Signal. This parameter defines the EIA signal that functions as the flow control signal from the PAD to the async device if EIA signal flow control is enabled. Choose one of the following signals: DSR, DCD, CTS, or NONE.

- ***Type of Data Restraint Input.*** Use this parameter to select the method the XL PAD uses to control the flow of data from the async device to the XL PAD. Enter XONXOFF if you wish to use XON/XOFF characters generated by XL PAD. Enter SIGNAL if you want to use the CTS (Clear To Send), DSR (Data Set Ready), or DCD (Data Carrier Detect) EIA signals the XL PAD generates. You can also enter NONE if you do not want the XL PAD to control data flow from the device to the XL PAD. ■ **Note:** Entering NONE for the type of data restraint input will override any setting you make for X.3 parameter 5. Enter ALL to select all options without using +.

- ***Bell Character.*** Your entry defines the character the XL PAD will send to the async device when the XL PAD rejects a character. Valid entries are ASCII characters from 0 to 255. ■ **Note:** These settings are the decimal equivalents of ASCII characters. See the decimal/hexadecimal/ASCII conversion chart in Chapter 7 to convert ASCII characters to their decimal equivalents. Enter 0 (zero) to disable the bell character entirely.

- *XOFF Character.* Your entry defines which character stops data flow from the async device or the XL PAD when XONXOFF is the output or input data restraint type. Valid entries are 0 to 255, except for characters 13 and 43. ■ **Note:** These settings are the decimal equivalents of ASCII characters. See the decimal/hexadecimal/ASCII conversion chart in Chapter 7 to convert ASCII characters to their decimal equivalents. If you enter 0 (zero), the XOFF character will not be used.
- *XON Character.* Your entry defines which character starts data flow from the async device or the XL PAD when XONXOFF is the output or input data restraint type. Valid entries are characters 0 to 255, except for characters 13 and 43. ■ **Note:** These settings are the decimal equivalents of ASCII characters. See the decimal/hexadecimal/ASCII conversion chart in Chapter 7 to convert ASCII characters to their decimal equivalents. If you enter 0 (zero), the XON character will not be used.

Asserted Connection Signal. This parameter defines the EIA signal(s) which are raised to connect the port to an async device, and dropped to disconnect from it. Choose from the following options (except for ALL and NONE, you may combine them in any order using +): DSR, DCD, CTS, ALL, or NONE.

Sensed Connection Signal. Use this parameter to define the EIA signal(s) that the async device raises to connect to a port, and drops to disconnect from it. Choose from the following options (except for ALL and NONE, you may combine them in any order using +): DTR, RTS, ALL, or NONE.

Asserted Invitation To Connect Signal. This parameter defines the EIA signal(s) that the PAD pulses to cause the async device to initiate a connection. Choose from among the following options (except for ALL and NONE, you may combine them in any order using +): DSR, DCD, CTS, ALL, or NONE.

Sensed Invitation To Connect Signal. This selection defines the EIA signal(s) that the async device pulses to cause the PAD to initiate a connection. Choose from the following options (except for ALL and NONE, you may combine them in any order using +): DTR, RTS, ALL, or NONE.

All Incoming Signals Must Be Active. This option affects the interpretation of two EIA signal functions: the Sensed Connection Signal and the Sensed Invitation to Connect Signal. One option is allowed per incoming EIA signal function. On any option you select, if the corresponding function is assigned to more than one EIA signal, all signals must be active for the PAD to consider the function active. Except for ALL and NONE, you may combine the options in any order using +.

- CONALL. All connection signals must be active.
- ITCALL. All invitation to connect signals must be active.
- ALL. Enables all of the above options.
- NONE. Resets all bits.

Disconnect Wait Timer Signal. Use this parameter to determine the number of seconds the PAD waits for the Sensed Connection Signal to drop after the PAD has dropped the Asserted Connection Signal. Choose from a range of 0 to 65,535. If you set this parameter to 0 (zero), the PAD waits indefinitely.

Connection Timer Interval. This parameter specifies the number of seconds the PAD will wait for an async connection to be established after either the Sensed or Asserted Connection Signal is raised. For this timer to expire without effect, autospeed detection and auto parity detection, if enabled, must have taken place, and the interface must be capable of transferring async data. If the async connection is not established by the time the connection timer expires, the PAD will drop the Asserted Connection Signal and return the port to its original state. The range is 0 to 65,535. Set the Connection Timer Interval to 0 (zero) if you want the PAD to wait indefinitely.

Asserted Connection Signal Options. This parameter controls the behavior of the connection signal asserted by the PAD. The CTRL option raises and lowers the connection signal as needed to connect and disconnect the async port. If you set the parameter to NONE, the Asserted Connection Signal is always active.

When to Raise Asserted Connection Signal to Initiate Connection. This parameter specifies conditions under which the PAD will initiate connection to an async device. Choose from the following options (except for ALL and NONE, you may combine them in any order using +):

- DITC. The PAD initiates connection on detection of an active Invitation to Connect signal.
- ICALL. The PAD initiates connection on receipt of an incoming virtual call.
- ACTV. The PAD makes connection when it completes initialization and activates ports.
- ALL. Enables all of the above options.
- NONE. The PAD never makes connection.

When to Drop the Asserted Connection Signal to Initiate Disconnection. This parameter defines conditions under which PAD will initiate disconnection of a port. Choose from the following options (except for ALL and NONE, you may combine them in any order using +):

- RCLR. The PAD disconnects a port on receipt of a clear request packet.
- ICLR. Disconnection occurs on a clear because of an Invitation to Clear PAD message.
- UCLR. The PAD disconnects a port if you clear by using the XL PAD command.
- EXPVCE. Disconnection occurs when Virtual Call Establishment Timer expires.
- ALL. Enables all of the above options.
- NONE. The PAD never disconnects.

When to Respond to the Sensed Connection Signal. Use this parameter to control the conditions under which the PAD considers itself to be connected with the async device. Choose from the following options (except for ALL and NONE, you may combine them in any order using +):

- UPWT. The PAD waits for an active Sensed Connection Signal from an async device in response to an active Asserted Connection Signal from the PAD. This means the PAD is prompting the async device by raising its EIA lines first.
- DNWT. The PAD waits for an inactive Sensed Connection Signal from an async device in response to an inactive Asserted Connection Signal from the PAD. This means the PAD tells the async device to drop connection and checks that it did so.
- UPRSP. The PAD responds to an active Sensed Connection Signal from an async device when a port is disconnected.
- DNRSP. The PAD responds to an inactive Sensed Connection Signal from an async device when a PAD port is connected.
- ALL. Enables all of the above options.
- NONE. The PAD never considers itself connected to the async device.

When to Pulse the Asserted Invitation to Connect Signal. This parameter determines the conditions under which the PAD pulses the Invitation to Connect signal. Choose from the following options (except for ALL and NONE, you may combine them in any order using +):

- X25UP. Pulse Asserted Invitation to Connect on X.25 link up detection.
- ICALL. Pulse Asserted Invitation to Connect on receipt of an incoming virtual call.
- ACTV. Pulse Asserted Invitation to Connect after PAD initialization of ports (XL PAD) are activated.
- ALL. Enables all of the above options.
- NONE. Never pulse.

Sensed Handshake Signal. Use this parameter to define the EIA handshake signal sent from the async device to the PAD. All of the following options except ALL and NONE may be combined using +: DTR, RTS, ALL, NONE.

Asserted Handshake Signal. This parameter defines the EIA handshake signal(s) sent from the PAD to the async device. All of the following options except ALL and NONE may be combined using +: DSR, DCD, CTS, ALL, NONE.

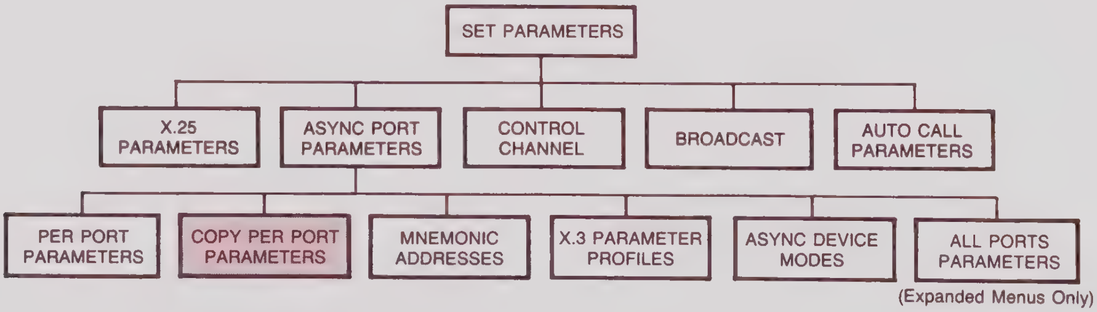
Copy Per Port Parameters. Enter 2 from the ASYNC PORT PARAMETERS menu to access the COPY PER PORT PARAMETERS menu. The Copy Per Port Parameters function copies the per port parameter settings of any port onto the per port parameters of one or more other ports. You select one source port number from 1 through 8 and then select one or more destination ports from 1 through 8. The port lists contain the currently active PAD ports. If you select an inactive port, the PAD considers that selection invalid.

For the destination port(s), you can enter either one port or a list of ports, using commas (1,2,3), plus characters (4 + 5 + 6), or a string with spaces but no characters (6 7 8). You can also enter a range of ports using a hyphen (4 - 6). In this case, always list the smaller number first. A range can also be part of a list, for example, 1, 2, 3 - 6, 7 + 8. To copy to all active PAD ports, enter an asterisk (*) as the destination port. If you enter only a comma (,), plus character (+), or ⟨CR⟩, no port parameters are copied.

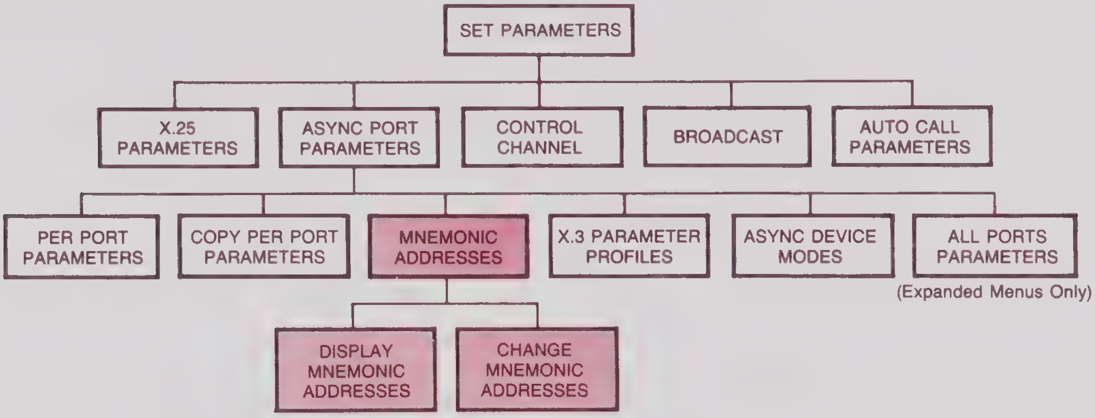
The copy function does not copy parameters which contain address information. The five special parameters that are not copied are Async Port Calling Address, User Data Pattern, User Data Mask, Default Listen Type, and Default Listen Pattern. All other per port parameters and the async device mode are copied. The source port's default X.3 profile is also copied to that of the destination port(s). All parameters accessible from the Main and Expanded Menus are copied.

If all the parameters on a destination port are the same as the parameters on the source port, the parameters are not copied and a message of **Parameters have not changed. No action taken.** is displayed. If you enter * as the source port, then the PAD considers port 1 as the source port. If you enter multiple ports as the source port, for example, 3,4,8, then the lowest value is used.

After all the destination ports are updated, the PAD activates the new parameter settings and displays the message **Parameters instated on running system on all copy destination ports.** If the PAD clears the virtual call into the control channel at any time during the copy process, copying to destination ports ceases. The new parameter setting is instated on all ports on which the copy was completed.



Mnemonic Addresses. Enter **3** from the ASYNC PORT PARAMETERS menu to access the MNEMONIC ADDRESSES menu. Mnemonic addresses are 1- to 10-character codes representing called addresses of up to 15 digits. The mnemonic address is usually a code name with special significance; it may be used in place of a numerical address in a CALL command you enter from an async device. The two submenus available under the MNEMONIC ADDRESSES menu are shown below:


SET PARAMETERS
X.25 PARAMETERS
ASYNC PORT PARAMETERS
CONTROL CHANNEL
BROADCAST
AUTO CALL PARAMETERS
PER PORT PARAMETERS
COPY PER PORT PARAMETERS
MNEMONIC ADDRESSES
X.3 PARAMETER PROFILES
ASYNC DEVICE MODES
ALL PORTS PARAMETERS
(Expanded Menus Only)
DISPLAY MNEMONIC ADDRESSES
CHANGE MNEMONIC ADDRESSES

- *Display Mnemonic Addresses.* Use this menu to view the current list of mnemonic address names and corresponding addresses. Go to the next selection if you want to create or change any of the mnemonic address names or numerical equivalents.
- *Change Mnemonic Addresses.* Use this menu to create or change any of the mnemonic addresses *or* their equivalent numerical addresses. Each mnemonic address name can contain letters, numerics (from 0 to 9), and underscore (_) characters, but must begin with a letter. As an example, one factory default mnemonic address has already been created: the control channel is named "CTP" and its corresponding address is 89. To initiate a virtual call to the XL PAD control channel from a local async device, you could key in either CALL CTP ⟨CR⟩ or CALL 89 ⟨CR⟩. When you are finished changing names and addresses, the XL PAD prompts you to exit with or without making your changes effective, or allows you to return to the Change Mnemonic Addresses selection. ■ **Note:** The XL PAD allows for a total of ten mnemonic addresses.

Enter **X ⟨CR⟩** to move back to the previous menu.

X.3 Parameter Profiles. Enter 4 from the ASYNC PORT PARAMETERS menu to access the X.3 PARAMETER PROFILES menu. CCITT specification X.3 (1984 version) contains a total of 22 parameters that determine PAD operation. In addition to the standard 22 parameters, there are four extra parameters offered in the XL PAD.

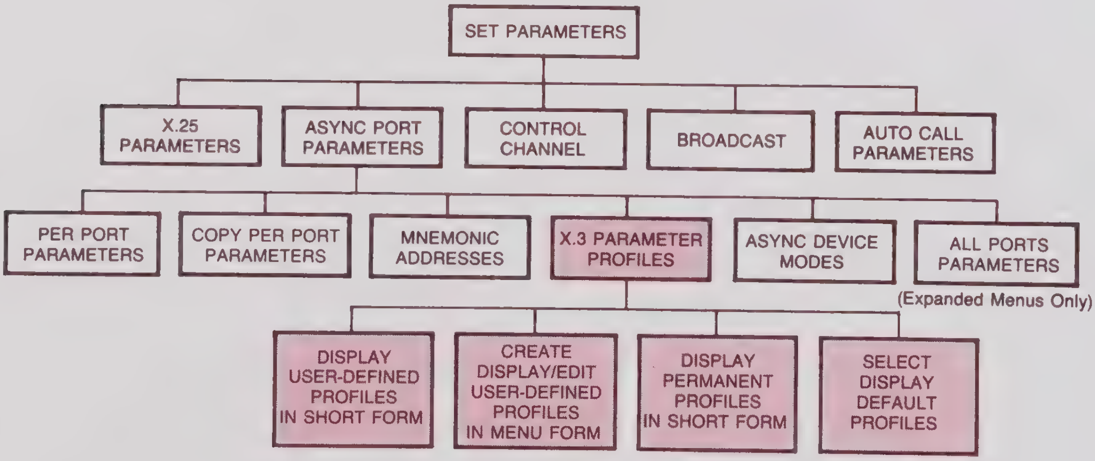
Configuring a PAD's X.3 parameters is a lengthy process. To reduce the complexity of configuring the X.3 parameters, standard parameter sets known as profiles can be programmed into the XL PAD. The profiles are designed so that all the X.3 parameters can be entered in one step for each async terminal port by selecting a default profile for the async port. Each profile is configured to make XL PAD use more efficient for different types of async DTEs.

There are two types of profiles you can select to aid in configuring X.3 parameters — permanent profiles and user profiles. Permanent profiles are set at the factory for common DTE equipment and applications. User profiles are created by you, and permit fine-tuning of the X.3 parameters governing your unique async DTEs or applications.

You can also use existing permanent or user profiles to create *new* user profiles by selecting a profile, editing some parameters, and renaming the profile. If a permanent and a user profile have the same name, then the user name is the active one. After you have set up profiles to match your application(s), you will be able to select a single profile to set X.3 parameters for a port rather than making 26 individual entries.

Note that most permanent profiles (except CC_TSP and SHARK) use a pseudo half-duplex method for displaying data a terminal sends to and receives from the XL PAD. This I/O (input/output) interleave method of displaying data is used to prevent the mixing of input and output data on a terminal display. As a consequence of I/O interleaving, incoming X.29 commands from the network to the XL PAD are not processed until you press the data forwarding key (default = ⟨CR⟩).

The following four sections describe how to display and copy permanent profiles and how to create and edit user profiles. If you are modifying or creating profiles, refer to the X.3 parameter guide in Chapter 7 for a list of the X.3 parameters and their complete definitions, or refer to the help text available on your screen for guidance while setting parameters. Once you have configured various profiles for the different types of equipment and applications in your network, you may not have further need to use selections 1 to 3.


SET PARAMETERS
X.25 PARAMETERS
ASYNC PORT PARAMETERS
CONTROL CHANNEL
BROADCAST
AUTO CALL PARAMETERS
PER PORT PARAMETERS
COPY PER PORT PARAMETERS
MNEMONIC ADDRESSES
X.3 PARAMETER PROFILES
ASYNC DEVICE MODES
ALL PORTS PARAMETERS
(Expanded Menus Only)
DISPLAY USER-DEFINED PROFILES IN SHORT FORM
CREATE DISPLAY/EDIT USER-DEFINED PROFILES IN MENU FORM
DISPLAY PERMANENT PROFILES IN SHORT FORM
SELECT DISPLAY DEFAULT PROFILES

- ***Display User Defined-Profiles in Short Form.*** Enter 1 from the X.3 PARAMETER PROFILES menu to display a list of current user-defined profiles on your screen. The short form display will list the name of each user profile followed by the reference number and current setting for each X.3 parameter. For instance, if you had created a user profile called "BACKUP," the following might be displayed on the screen:

  ```
  PROFILE ID: BACKUP
  X.3 PARAMS: 1:0, 2:0, 3:0, 4:20, 5:0, 6:0, 7:2,...(etc)....22:0
  EXTRA PARAMS: LCL 0, REM 0, EXP 1, HDX 0
  ```

  In this example, the setting for parameter 1 is 0, parameter 2 is 0, parameter 3 is 0, and so on. To further interpret the short-form display, you must either be familiar with the X.3 parameters by reference number or refer to the X.3 parameter guide in Chapter 7. If there are no user profiles configured yet, as in an initial startup, the PAD will generate a NO USER PROFILES message.

- ***Create/Display/Edit User-Defined Profiles in Menu Form.*** Enter 2 from the X.3 PARAMETER PROFILES menu to create, display, or edit a user profile. Once CREATE/DISPLAY/EDIT USER-DEFINED PROFILES IN MENU FORM appears, enter menu selections 1, 2, or 3 if you want to create a new user profile from an existing profile with just a few changes, or enter selection 4 to create a new profile with initial values displayed as zero.

  ■ **Note:** If you are creating a new user profile for a *non*interactive application, the I/O interleave method of displaying data (see explanation in the X.3 Parameter Profiles section) is *not* required. For this type of application, you must set X.3 parameter reference numbers 1, 2, 6, and 15 to zero (0). In addition, X.3 parameter reference number 7 must not have a setting that allows the terminal to escape the data transfer mode. For detailed descriptions of all the X.3 parameters, refer to Chapter 7 or to the help text (enter ?) before you make a parameter entry.

  ```
  CREATE/DISPLAY/EDIT USER-DEFINED PROFILES IN MENU
  FORM
  To create a new profile definition:
  1〉 Edit an existing user-defined profile
  2〉 Edit a permanent profile
  3〉 Return to a previous profile edit
  4〉 Start with a blank profile
  ```

  Menu selection 1 allows you to choose an existing user profile as the basis for a new user profile. If no user profiles are created yet, enter selection 2 to use a permanent profile (see Table 3-3) to create a new user profile. Use selection 3 if you want to go back to the last profile that was edited to make further changes to that profile. You can re-edit the selected profile regardless of whether you have made the changes effective or not. ■ **Note:** If the PAD is power-cycled, or if PAD reboot, system reboot, or reload factory defaults are executed, selection 3 is invalid until a profile is edited.

  To construct an entirely new profile, starting with only zero default values displayed, enter selection 4. If you construct a new profile and elect to exit the menu selection and make your changes effective, the PAD prompts you to add the new profile to the table of existing profiles or to replace an existing profile with the new one by selecting one of the following choices:

  ```
  How to save the profile:
  [1] Insert in a blank slot in the table
  [2] Overwrite an existing profile in the table
  ```

  ■ **Note:** The PAD only allows replacement (overwrite) of user profiles.

  If you select 2 from the preceding choices, the PAD then asks which existing user profile you want to overwrite. If you have created a new user profile with the same name as a permanent profile, it is not necessary to overwrite an existing permanent profile in the table. Whenever you create a user profile with the same name as a permanent profile, the user profile settings will take precedence. Permanent profiles cannot be overwritten.

  Enter X 〈CR〉 to return to the previous menu.

Table 3-3.
Permanent Profiles

Name	*DTE Type and Application*
DEFAULT	Factory default. Will work with most types of DTE equipment and async applications. May not be as efficient as other profiles because it accommodates many types of DTEs.
CC_SSP	X.3 Simple Standard Profile. CCITT X.3 recommended settings for interactive, two-way communications. Allows command mode recall, bidirectional flow control, and local echo.
CC_TSP	X.3 Transparent Simple Profile. CCITT X.3 recommended settings for batch or file transfer. No flow control, echo, editing, or command mode recall between device and PAD.
CRT	Use with most types of async ASCII CRTs. Enables PAD flow control, local echo, editing, and command mode recall.*
HARDCOPY	Use with most types of async ASCII printers or printer terminals. Enables command mode recall, bidirectional flow control, local echo, and editing.*
HDX	Use for half-duplex applications. Enables command mode recall, bidirectional flow control, local echo, and editing.
SCEN	Test scenario for technical support reference. Not recommended for general use.
SHARK	Custom permanent profile. Not recommended for general use.

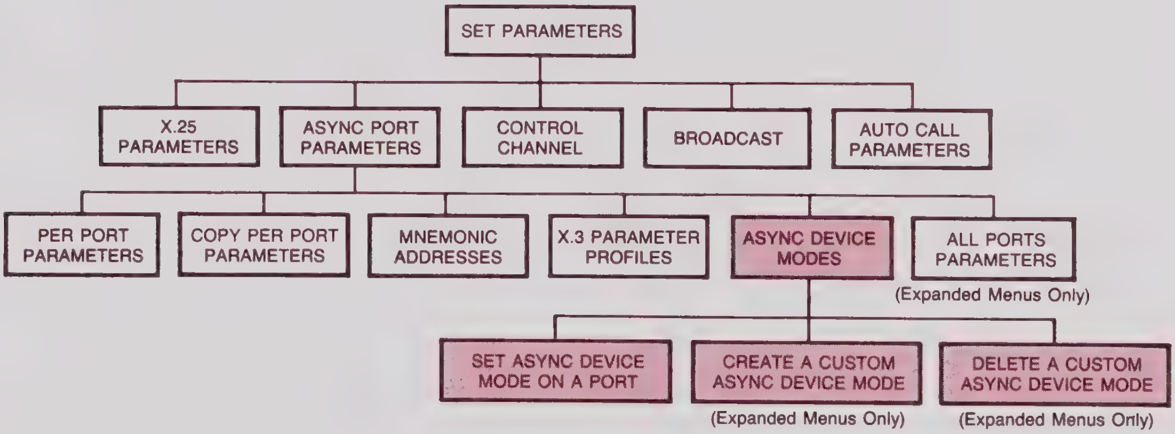
*These profiles are most commonly used.

- ***Display Permanent Profiles in Short Form.*** Enter 3 from the X.3 PARAMETER PROFILES menu to display the permanent profiles and their parameters on your screen. The short-form display lists the name of each permanent profile followed by the reference number and current setting for each of the profile's X.3 parameters. To interpret the short-form display, you must either be familiar with the X.3 parameters by reference number or refer to the detailed X.3 description in Chapter 7. Refer to Table 3-3 for a brief description of permanent profiles and their uses.
- ***Select/Display Default Profiles.*** Enter 4 from the X.3 PARAMETER PROFILES menu to display and then select a default profile for each port. The XL PAD prompts you to select a port number and then displays the default profile currently in effect on that port, followed by a list of all available profiles. Enter one of the profiles listed, or key in ⟨CR⟩ to keep the current default profile in effect. A new default profile is not enabled until the corresponding port is rebooted, or the port is disconnected by unplugging the EIA connector, or the async device is power cycled.

  Enter X ⟨CR⟩ to return to the previous menu.

Async Device Modes. Async device modes are macro configuration commands which dictate how the XL PAD will handle several parameters for the async device attached to a port, including EIA data set signals, baud rate, parity, stop bits, data bits per character, autospeed, and auto parity. The async device modes provide support for async devices that are commonly used, but can be tailored through the PER PORT PARAMETERS menu for your specific application.

The ASYNC DEVICE MODES menu can be reached by selecting 5 from the ASYNC PORTS PARAMETERS menu. The ASYNC DEVICE MODES menu has one selection available from the Main Configuration Menu (''Set async device mode on a port'') and two selections available only from the Expanded Menu (''Create a custom async device mode'' and ''Delete a custom async device mode'').


SET PARAMETERS
X.25 PARAMETERS
ASYNC PORT PARAMETERS
CONTROL CHANNEL
BROADCAST
AUTO CALL PARAMETERS
PER PORT PARAMETERS
COPY PER PORT PARAMETERS
MNEMONIC ADDRESSES
X.3 PARAMETER PROFILES
ASYNC DEVICE MODES
ALL PORTS PARAMETERS
(Expanded Menus Only)
SET ASYNC DEVICE MODE ON A PORT
CREATE A CUSTOM ASYNC DEVICE MODE
(Expanded Menus Only)
DELETE A CUSTOM ASYNC DEVICE MODE
(Expanded Menus Only)

To set an async device mode for a port, enter 1 from the ASYNC DEVICE MODES menu, wait for the prompt, and then enter the port number. Four async device modes are available for standard applications:

- *KILL.* Enter this async device mode if you want to logically disconnect the port. The XL PAD will not sense EIA signals at any port with the KILL mode in effect. ■ **Note:** Entering the KILL mode for the port you are using to configure the control channel causes the XL PAD to ignore any further transmissions from the device you are using. To reinstate communications on a port with the KILL mode enabled, you must change the async device mode of the port from a different local or remote device.

- ***AUTOSPD.*** Enter the autospeed async device mode if you want the PAD to perform automatic baud rate detection on the connected device. EIA signals DSR, CTS, and DCD are always raised by the PAD if you select this device mode. However, the async device is not logically connected until it raises EIA signals RTS or DTR and the XL PAD has sensed the baud rate of the device after monitoring several ⟨CR⟩ characters. After the speed has been sensed and checked, the PAD responds to the terminal with the command mode prompt.

  The autospeed async device mode also allows you to reestablish a new baud rate between your terminal and the PAD. When signals RTS and DTR are lowered, as is the case if you power off the device or restart the port (see Chapter 4), the XL PAD resenses the new baud rate when you power up the device again or when the port restart is completed. The AUTOSPD async device mode is the factory default and most common setting.

- ***DIRECT9600.*** Enter this async device mode if you want the attached async device to remain logically connected to the port at all times. The XL PAD ignores incoming EIA signals and always asserts DSR, CTS, and DCD on an async port with DIRECT9600 enabled. In order to use this device mode, your async device must meet the following prerequisites: the attached device must send 8 bits per character, cannot generate or check parity, and must have a baud rate of 9600 bps. Since an async device that uses the DIRECT9600 mode is always logically connected, you can issue commands to the async device or have the device issue an auto call immediately upon powerup. You can set this mode and alter default speed in the PER PORT PARAMETERS menu if a different speed is desired.

- ***DIALIN.*** Enter this async device mode if you have a dial-in modem connected to the selected port. If you have selected the DIALIN mode, the XL PAD will assume a DCE-DCE connection (using a crossover cable) for that port, and will handle EIA signals accordingly: EIA signals DSR, CTS, and DCD generated by the PAD follow the incoming signals DTR and RTS.

  The DIALIN mode also has the autospeed feature described under the AUTOSPD mode, but has several restrictions made necessary by the remote DTE connection through a pair of modems. The restrictions are as follows:

  - Auto parity must be enabled for the port.
  - The XL PAD disconnects the async device if the PAD cannot sense the baud rate or parity within 120 seconds of either RTS or DTR being raised.
  - The XL PAD drops DSR, CTS, and DCD to disconnect the device if a virtual call has not been established within 600 seconds of speed and parity detection by the PAD.
  - The XL PAD waits 60 seconds after signals DTR or RTS have been dropped before it considers the async device disconnected, after which time the device must undergo speed and parity detection again to be reconnected.

Async Device Modes — Expanded Menus Only

- ***Create a Custom Async Device Mode.*** This selection allows you to create one or more macro configuration command(s) which determine how the XL PAD will handle several parameters for the async device attached to a port. These parameters are EIA data set signals, baud rate, parity, stop bits, data bits per character, autospeed, and auto parity. The async device mode you create can be tailored through the PER PORT PARAMETERS menu for a specific application. After configuring the per port parameters for a port, the Create a Custom Async Device Mode selection is used to assign that port configuration to an async device mode macro with a user-defined name. This name is added to the list of async device modes.

- ***Delete a Custom Async Device Mode.*** This selection allows you to remove async device modes from the async device mode list. For example, if a new mode is not allowed into the list because the list is full, use the Delete a Custom Async Device Mode selection to open a position.

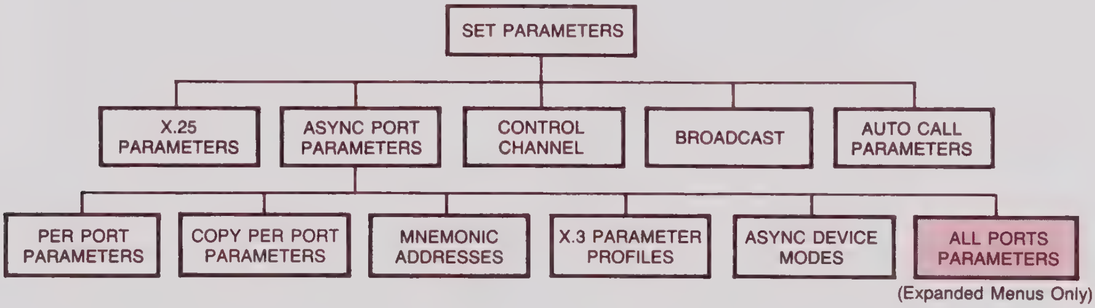
  Enter X ⟨CR⟩ to return to the previous menu.

All Ports Parameters (Expanded Menus Only). Access this menu by selecting 6 from the ASYNC PORT PARAMETERS menu. The Incoming Call Wait Timer Interval, Virtual Call Establishment Timer Interval, and the Speed Sense Timer Interval parameters affect all ports and appear only in Expanded Menus. See Table 3-4 for a list of the All Ports Parameters and their default settings.

Table 3-4.
All Ports Parameters

All Ports Parameter	*Valid Entries*	*Default*
Incoming Call Wait Timer Interval	0 to 65,535 seconds	120
Virtual Call Establishment Timer Interval	0 to 65,535 seconds	600
Speed Sense Timer Interval	1 to 20 seconds	3

- ***Incoming Call Wait Timer Interval.*** This selection defines the number of seconds the PAD waits for an incoming call to connect to a port before the PAD clears the call. Choose from a range of 0 to 65,535 seconds.

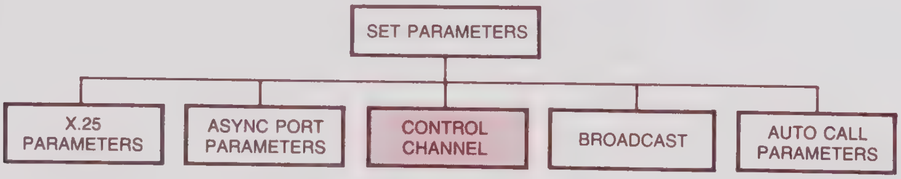

SET PARAMETERS
X.25 PARAMETERS
ASYNC PORT PARAMETERS
CONTROL CHANNEL
BROADCAST
AUTO CALL PARAMETERS
PER PORT PARAMETERS
COPY PER PORT PARAMETERS
MNEMONIC ADDRESSES
X.3 PARAMETER PROFILES
ASYNC DEVICE MODES
ALL PORTS PARAMETERS
(Expanded Menus Only)

- ***Virtual Call Establishment Timer Interval.*** This parameter represents the number of seconds the PAD waits for a device connected to an async port to establish a virtual call before disconnecting the device. This parameter has no effect if disconnection on Virtual Call Establishment Timer Interval expiration is not enabled for the port. This means that the XL PAD port will be disconnected when the timer expires and a virtual call is not established. (See "When to Drop the Asserted Connection Signal to Initiate Disconnection" in the PER PORT PARAMETERS menu.) Choose from a range of 0 to 65,535 seconds.
- ***Speed Sense Timer Interval.*** Use this parameter to fine-tune automatic speed detection when auto baud is enabled under Per Port Parameters. Choose from a range of 1 to 20 seconds.

  Enter X ⟨CR⟩ to return to the previous menu.

Control Channel

This menu has three parameters that allow you to determine call request packet routing and the address for the control channel. Select 3 from the SET PARAMETERS menu to access the control channel menu.



The parameters that determine the control channel address and call request packet routing are as follows:

Address. This address routes call request packets from the local async devices and those coming in from the network to the control channel. To set up an address for the control channel, enter up to 15 characters in decimal form. Wild-card characters may be used in the control channel address, but to avoid the possibility of routing an outgoing call to the network back to the control channel, enter a full-form address. After you enter the address, all call request packets must have an address field exactly matching your entry in order to be routed to the control channel.

User Data Pattern. In addition to the address, some networks use a portion of the user data field of call request packets to supply further routing information. The user data pattern you enter is compared to the first sixteen bytes of the user data field of call request packets, which can be entered in hex or ASCII form. Quotes must enclose ASCII characters in your entry, but are not part of the data pattern. For example: "CTRL CHANNEL" might be entered as your user data pattern, which would be equivalent to 4354524C204348414E4E454C in hexadecimal form. When entered as hexadecimal, you must use an even number of digits or the entry is ignored and the current value is maintained.

User Data Mask. Before the user data fields of call request packets are compared to the user data pattern, both are first screened by the user data mask. The mask acts as a screen by allowing the XL PAD to compare only certain character positions in the user data field of incoming packets against the same character positions in the user data pattern. You can use this feature to provide wider access to the control channel based on the unmasked portions of the user data pattern and the user data field of call request packets.

Enter hexadecimal character 00 if you want to cause a match between the user data pattern and user data field characters in the 00 character position. If you enter all 00 characters, all incoming user data fields will automatically match the user data pattern. Enter hexadecimal character FF for those positions in the user data pattern and user data field you would like compared for an exact match. You can enter up to 16 sets of hexadecimal characters to configure the user data mask. If you enter fewer than 16 sets of 00 or FF hexadecimal characters, the XL PAD will automatically append 00 characters to the right of those you have entered. These appended 00 characters are not displayed.

Example: User Data Pattern = "My Example"

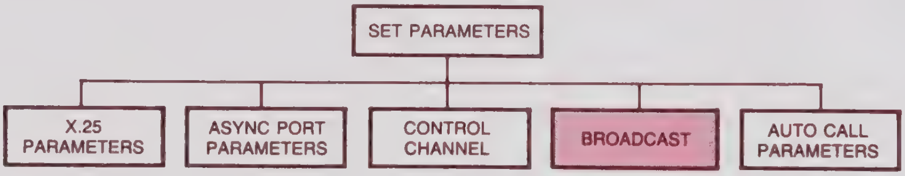
User Data Mask = FF FF FF FF FF FF FF FF FF
00 00 00 00 00 00

■ **Note:** The first four bytes could be the 01000000 PAD protocol identifier (CCITT). If a match is specified for the first four bytes and the PAD protocol identifier is present then the Data Pattern must include the PAD protocol identifier. The Data Mask must check for the PAD protocol identifier in the first four bytes.

Broadcast

The broadcast feature is useful anytime a remote DTE needs to send a message to a group of devices connected to the local XL PAD. The eight broadcast channels are each capable of routing a bulletin message from a remote DTE to a maximum of eight terminal ports at the same time. An example of such a broadcast channel message might be a ticker-tape display of stock prices. You will not see any broadcast displays on your local async device if you are using the device to access the local control channel; all broadcast traffic to an async device is suspended while the local async device accesses the local control channel, but functions normally if you are accessing a remote control channel. Broadcast traffic is not suspended.

Select 4 from the SET PARAMETERS menu to access the BROADCAST menu.


SET PARAMETERS
X.25 PARAMETERS
ASYNC PORT PARAMETERS
CONTROL CHANNEL
BROADCAST
AUTO CALL PARAMETERS

The BROADCAST menu consists of six parameters used to determine the operation of a broadcast channel. There are eight separate broadcast channels.

Address. This address routes call request packets coming in from the network to a broadcast channel. To set up an address for any of the 8 broadcast channels, enter up to 15 characters in decimal form. As described in the addressing section of Chapter 1, the asterisk (*) wild-card character can match any number of characters (depending on where it is entered), while the question mark (?) wild-card can match any single character. After you enter a broadcast channel address, an incoming call request packet with an address matching your entry is routed to that same broadcast channel.

User Data Pattern. In addition to the address, some networks employ a portion of the user data field of incoming call request packets to supply further routing information. The user data pattern you enter is compared to the first 16 bytes of the user data field of incoming call request packets. Enter up to 16 bytes in hexadecimal characters or ASCII characters enclosed in quotes. For example: "My Broadcast" might be entered as your user data pattern, which would be equivalent to 4D792042726F616463617374 in hexadecimal. As with the user data pattern for the control channel, spaces are counted as part of the pattern, but quotes are not. When entered as hexadecimal, you must use an even number of digits or the entry is ignored and the current value is maintained.

User Data Mask. Before the user data fields of incoming call request packets are compared to the user data pattern, both are first screened by the user data mask. The mask acts as a screen by allowing the XL PAD to compare only certain character positions in the user data field of incoming packets against the same character positions in the user data pattern. You can use this feature to provide wider access to a broadcast channel based on the unmasked portions of the user data pattern and the user data field of incoming call request packets.

Enter hexadecimal character 00 if you want to cause a match between the user data pattern and user data field characters in the 00 character position. If you enter all 00 characters, all incoming user data fields will automatically match the user data pattern for a broadcast channel. Enter hexadecimal character FF for those positions in the user data pattern and user data field you want to compare for an exact match. You can enter up to 16 sets of hexadecimal characters to configure the user data mask. If you enter less than 16 sets of 00 or FF hexadecimal characters, the XL PAD will automatically append 00 characters to the right of those you have entered. These appended 00 characters are not displayed.

Example: User Data Pattern = "My Example"

User Data Mask = FF FF FF FF FF FF FF FF FF
00 00 00 00 00 00

■ **Note:** The first four bytes could be the 01000000 PAD protocol identifier (CCITT). If a match is specified for the first four bytes and the PAD protocol identifier is present then the Data Pattern must include the PAD protocol identifier. The Data Mask must check for the PAD protocol identifier in the first four bytes.

Broadcast Channel Receivers. This parameter specifies which async port receives a broadcast message coming into a broadcast channel from the network. You can enter a list of ports using commas (1,2,3), plus characters (4 + 5 + 6), or no characters (6 7 8). You can also enter a range (4 - 6) using a hyphen; the lower-numbered port must be entered first. A range can be part of a list, and the asterisk (*) is short for all possible ports. ■ **Note:** Do not allow different broadcast channels to send information to the same receiver ports if multiple data packets with mbit sequences will be sent to the shared receiver port(s) simultaneously.

Broadcast Parameters — Expanded Menus Only

See Table 3-5 for a list of Broadcast parameters and their default settings.

Table 3-5.
Broadcast Parameters

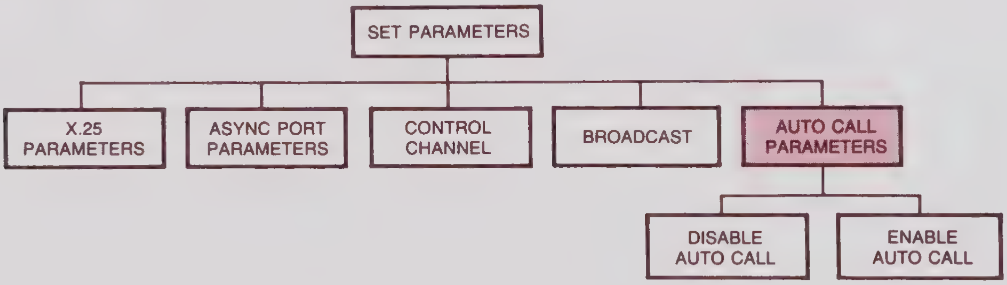
Broadcast Parameter	*Valid Entries*	*Default*
Maximum Packets Per Port	1 to 80 packets	10
Longest Mbit Sequence Port	@103 = to Maximum Packets Per Port above	5

Maximum Packets Per Port. This parameter defines the maximum number of packets that queue at each broadcast receiver port. The range is 1 to 80.

Longest Mbit Sequence. This parameter specifies the maximum number of mbit sequences. An mbit sequence is a message broken among several frames. If a longer mbit message is received, then a partial message may be delivered to some receivers as a result of data restraints. Though some packets are lost, the first and last packets are always present. Mbit sequences equal to or shorter than the length you establish will be sent or discarded in their entirety. Longest Mbit Sequence must be ‹=Maximum Packets Per Port.

Auto Call Parameters

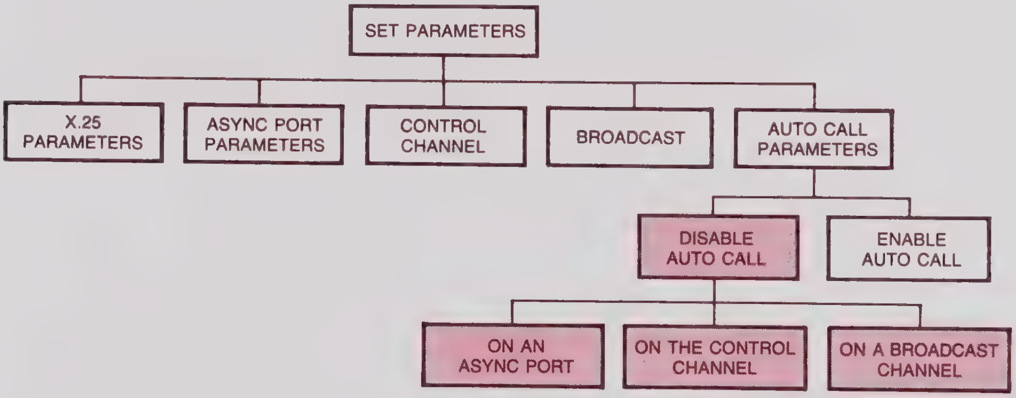
The auto call feature is a convenient means of making a virtual call and establishing a virtual circuit with a remote DTE without keying in an address. This feature is useful if you place calls to the same remote device every time you transmit data from a given local device. After you have set all the auto call parameters and enabled auto call for an async port, or control or broadcast channel, the XL PAD places a call to the pre-selected address when the async device is logically connected on an async port. If the X.25 packet level is up, a call will automatically be placed for the control channel or broadcast channel. The various contingencies for logical connection of the device depend on the async device mode selected for the corresponding async port, as described earlier in this chapter. Enter 5 to select the AUTO CALL PARAMETERS menu from the SET PARAMETERS menu.



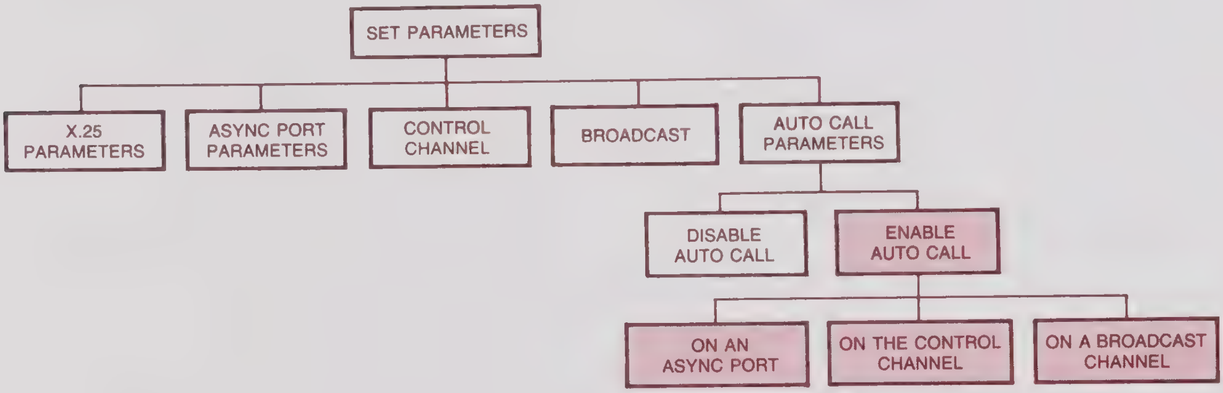
The AUTO CALL PARAMETERS menu has two submenus that permit you to enable or disable the auto call feature on any of the XL PAD ports or channels. The submenus and their parameter choices follow:

Disable Auto Call. Use this submenu selection to disable the auto call feature on a single port or channel. Auto call should be disabled if you randomly call several remote devices from the same local device. If you enter selection 1 or 3, the PAD returns a prompt asking you on which async port or broadcast channel you would like auto call disabled. If you enter selection 2, auto call is disabled on the control channel immediately after you key in the selection number.

Enter X ⟨CR⟩ to move back one menu.


SET PARAMETERS
X.25 PARAMETERS
ASYNC PORT PARAMETERS
CONTROL CHANNEL
BROADCAST
AUTO CALL PARAMETERS
DISABLE AUTO CALL
ENABLE AUTO CALL
ON AN ASYNC PORT
ON THE CONTROL CHANNEL
ON A BROADCAST CHANNEL

Enable Auto Call. Use this submenu selection to enable the auto call feature on a single port or channel. Enter selection 1, 2, or 3 to access the auto call parameters for an async port, the control channel, or a broadcast channel. Once you have made an entry for each of the parameters, the auto call feature is enabled for the port or broadcast/control channel you selected.



The auto call parameters are the same for all the async ports and broadcast/control channel(s), and are displayed on your screen as follows:

- ***Auto Call Delay Interval.*** Enter the number of seconds you want the XL PAD to wait between call clearing and the next call request when you have enabled the auto call feature. If you intend to occasionally call a destination other than the auto call address, you need not disable auto call if you set the auto call delay interval long enough to enter a CLEAR command followed by a CALL command (see Chapter 5) for the alternate destination address. The valid range for this parameter is 0 to 65,535 seconds, however, a setting of 0 will prevent any retries to establish a virtual circuit after the initial call is accepted and/or cleared. ■ **Note:** To prevent possible network service problems in some applications, it is suggested that you set the auto call delay intervals at least two seconds apart for each port.

- ***Auto Call Address.*** Enter up to 15 digits that specify the DTE address and subaddress of the remote device you want to call automatically when the local port or channel is active.

- ***Auto Call Facilities.*** Use this parameter to configure the facilities field of call request packets that will be sent from the XL PAD when auto call is enabled. Enter up to 62 hexadecimal characters for the facilities and settings you want to enable between two XL PADs. Packet size negotiation (facilities code 42) and window size negotiation (facilities code 43) are the standard facilities for the XL PAD and are automatically sent with default values if you do not enter the auto call facilities parameter and the NPWS option is selected for the Packet Level Options under the X.25 parameters. As an example of an auto call facilities setting, you might combine packet and window size settings with their values on each end of the network as in the following example:

  430606420707

  As shown above, the setting for the window size (facilities code 43) is 6 for both sides of the network. The value for the packet size setting (facilities code 42) is expressed as a logarithm of base 2, so 2^7 would equal a packet size setting of 128 bytes for both sides of the network.

- ***Auto Call User Data.*** Use this parameter to enter the login password of a remote host DTE, to send a brief message in the call request packet, or for alternate addressing of the remote device when subaddressing is not supported in the network you are using. Enter up to 16 bytes of data you want included in the user data field of outgoing call request packets.

User Data Fields. Only the AUTO CALL PARAMETERS menu defines a user data field for outgoing calls. You may enter up to 16 bytes of data as an intermix of hex and/or ASCII. You must enter an even number of hex characters, because two hex characters are stored as one byte. All ASCII character strings must be enclosed in double quotes. An example of a valid user data field is shown below:

```
0101A9"User data"6843
```

You can see that each hex string has an even number of characters and the ASCII string is surrounded by double quotes. If you enter data in the wrong format, the last accepted data remains as the user data and is echoed back to you when a ⟨CR⟩ is entered. If you need to define a protocol ID field within the call request packet, you must specify it in the user data field consistent with applicable standards or applications.

The factory default for this field is an empty call user data field, meaning that no protocol ID field is transmitted. If the PAD makes an auto call after installing factory defaults, there is no user data or protocol ID within the call request packet. When you enter a valid data pattern as the user data, the data is inserted in the call user data field of the call request packet. If you want to delete a previously defined user data field, enter an asterisk (*) followed by a ⟨CR⟩ when you are prompted for the user data field. This clears the field.

Enter X ⟨CR⟩ to move back one menu. Enter another X ⟨CR⟩ at the AUTO CALL PARAMETERS menu to move back one more menu. You should now be at the SET PARAMETERS menu.

Chapter 4
Rebooting the PAD

Contents

General 4-1
Start Over on a Port 4-2
Restart Packet Level 4-3
Reboot the PAD 4-3
Reinstate Factory Parameter Settings 4-3
Reboot the Entire System 4-3

GENERAL

As discussed in Chapter 3, many of the XL PAD parameter settings do not take effect immediately when you enter them. The settings are stored in the PAD's memory, but do not affect the PAD's operation until you perform a reboot procedure. This chapter explains how to reboot the async ports, XL PAD, and the XL PAD/modem combination. Two additional procedures are also described: reinstating the factory parameter settings and restarting the packet level from the PAD to the network.

You can access the reboot, restart, and reinstate procedures by placing a virtual call to the control channel as described in Chapter 3, "Using the Control Channel," Steps 1 through 5. Remember that if you changed the control channel address while setting parameters, you must enter the new control channel address rather than the factory default addresses of CTP or 89. Once you have the PAD CONFIGURATION MAIN MENU displayed on your screen, enter selection 4 to access the Restart Menu, shown below.

```
RESTART MENU (1.4)
1) Start over on a port
2) Restart packet level
3) Reboot the PAD
4) Reinstate factory parameter settings
5) Reboot the entire system
Enter number (X to Exit):
```

The following sections of this chapter describe the RESTART MENU selections and functions in their order of appearance in the menu, although you may enter selections in any order. ■ **Note:** When you enter any of the following selections, your virtual circuit to the control channel will be disconnected, except when you enter Restart Packet Level when locally connected or Start Over on a Port for a port you are not using to access the control channel.

START OVER ON A PORT

This selection could also be called "Reboot a Port:" it is the least disruptive of all the Restart Menu selections, and does not result in disconnection from the control channel unless you restart the port you used to call the control channel. Use this selection to clear the virtual circuit on a port and maintain all parameter settings currently in effect until the next virtual call.

The Start Over on a Port selection is especially useful because it eliminates the need to visit each local terminal to disconnect calls in progress. You can disconnect several terminals at your local site by repeatedly entering the Start Over on a Port selection followed by the port numbers of the local terminals you want to disconnect. You may also wish to use the Start Over on a Port selection if the auto call feature is enabled for a port and you have just changed that port's auto call address. If you enter Start Over on a Port after making this change, the call to the original destination address is disconnected and another call is placed automatically to the new destination address.

To start over on a port, enter 1 from the RESTART MENU. Following your selection, the XL PAD prompts you to enter a port number. Once you have entered the number of the port you want to restart, the XL PAD acknowledges your entry with a message like "Port #1 started over." When the port is started over, you can place virtual calls again. If you have enabled AUTO CALL, the XL PAD will place a virtual call to the remote device you specified as soon as the port is restarted.

RESTART PACKET LEVEL

Use this selection to restart the packet level of all virtual circuits you have set up through the XL PAD. When you restart the packet level, all virtual calls are cleared and the packet level is reinitialized. The restart procedure is normally used only in the case of a serious problem in the network, such as a power failure or inability to establish any virtual circuits. ■ **Note:** When you enter the Restart Packet Level selection, undelivered packets in the network may be lost. In addition, if you are accessing a remote XL PAD and enter the Restart Packet Level selection, the virtual circuit is cleared and you are disconnected from the remote PAD's control channel. Use this selection with caution.

To restart the packet level, enter selection 2 from the RESTART MENU. The XL PAD will return a prompt to confirm that you want to restart the packet level. Enter y (for yes) to Reset the packet level or n (for no) to return to the RESTART MENU.

If you enter y to restart the packet level and the XL PAD does not receive a restart confirmation packet from the remote DTE, the local XL PAD retransmits a restart request packet up to 255 times at 180-second intervals. The XL PAD then restarts the packet level without an acknowledgement.

REBOOT THE PAD

Use this selection to enable your changes to all XL PAD parameters that are preceded by an asterisk (*). This procedure is similar to starting over on a port, but in this case all the async ports in the XL PAD are reinitialized simultaneously. If you have not made any changes to any XL PAD parameters, the existing parameter settings will be reloaded into the configuration memory. When you reboot the XL PAD, any virtual calls in progress are cleared and the PAD is reset with the current parameter settings. As a result of rebooting the XL PAD, your virtual circuit to the control channel is also disconnected.

To reboot the XL PAD, enter 3 from the RESTART MENU. The control channel will return a prompt to verify your decision to reboot the XL PAD. Enter y to clear all virtual circuits and enable parameters preceded by an asterisk (*). Enter n to return to the RESTART MENU.

REINSTATE FACTORY PARAMETER SETTINGS

Use this selection to replace all PAD parameter settings with the factory default settings. When you enter the Reinstate Factory Parameter Settings selection, any settings (except front panel settings) you entered since the initial power-up of the XL PAD *are replaced by the factory default settings,* and the entire XL PAD is rebooted. As a result of reinstating factory parameter settings, your virtual circuit to the control channel is also disconnected.

To reinstate factory parameter settings, enter 4 from the RESTART MENU. The XL PAD will return a prompt to confirm your entry. Enter y to reinstate all the default factory settings and reboot the XL PAD. Enter n to return to the RESTART MENU.

REBOOT THE ENTIRE SYSTEM

This selection is normally entered by service personnel only. The "entire system" refers to the modem/XL PAD combination. Use this selection to reinitialize the modem and XL PAD option. Rebooting the entire system affects all communications at a site and will cause the modem/XL PAD to retrain; all virtual circuits and calls in progress are cleared. This selection has the same effect as cycling power to the modem/XL PAD off and then on again.

To reboot the entire system, enter 5 from the RESTART MENU. The XL PAD will return a prompt to confirm your entry. Enter y to reboot the entire system or n to return to the RESTART MENU.

Chapter 5
Using the PAD

Contents

General 5-1
Data Transfer Mode 5-2
  Placing Calls 5-2
  Clearing Calls 5-2
Command Mode 5-3
  Accessing the Command Mode 5-3
  Commands 5-3
The Incoming Call Display 5-9

GENERAL

Once you have performed the initial setup of parameters for operating your async terminals through the XL PAD (see Chapter 3), you are ready to place virtual calls and begin data transmissions over your X.25 network. The two modes that allow you to communicate with the XL PAD or with a remote DTE are described in this chapter, and the procedures for accessing, using, and exiting each mode are also described. ■ **Note:** The descriptions that follow have two prerequisites: Following the instructions in Chapter 3, you must select Async Device Mode AUTOSPD and X.3 profile CRT. You must enter both of these selections before using the instructions in the remainder of this chapter.

The two modes you can access from your local terminal are as follows:

- Data Transfer Mode. When you place a virtual call to a remote DTE from your local terminal and have established a virtual circuit, the two locations are in the data transfer mode.
- Command Mode. You can enter commands to the local XL PAD to redefine DTE-PAD and PAD-PAD operation in your X.25 network without using the control channel. When you first power on your terminal (without auto call enabled) and press ⟨CR⟩, or enter the PAD recall character (@) when in the data transfer mode, the XL PAD shifts to the command mode and you can enter one of the commands described later in this chapter.

DATA TRANSFER MODE

To begin communicating on an X.25 network, you must first establish a virtual circuit between the remote DTE and your local DTE and XL PAD. This section describes how to enter or leave the data transfer mode by placing or clearing virtual calls. You can also suspend data transfer without clearing the virtual circuit by entering the PAD recall character.

Placing Calls

To begin communicating with a remote DTE, you must place a virtual call from an async terminal connected to the XL PAD by using the CALL command. Once you have completed this procedure, and a logical channel is established between the local and remote devices, you will be in the data transfer mode. To place a virtual call and access a logical channel for communications with the remote device, complete the following steps:

1) Power on a local async CRT, wait for the cursor to appear, then press ⟨CR⟩ several times. If you have enabled auto call while setting XL PAD parameters, proceed directly to Step 3 below, otherwise a message similar to the following appears on your screen:

```
GCOM PAD V2.0: ASYNC PORT # 1, 9600 BAUD
*
```

2) The asterisk (*) displayed on your terminal is generated by the XL PAD to prompt you to enter a command, and also signals you that the terminal you are using is in the command mode. To place a call to a remote DTE, you must know the network address of the DTE. After the asterisk is displayed, enter the CALL command and the address of a remote DTE. In the example below, substitute the decimal or mnemonic address for the characters *xxxxxxxxxxxxxxx*.

```
CALL xxxxxxxxxxxxxxx
```

3) If the remote X.25 device or XL PAD is configured with a network address that matches the address you just called (or the address sent automatically if auto call is enabled), your call is accepted and the remote DTE sends its normal message to log on. Complete your usual logon procedure and begin transmitting data.

Clearing Calls

Clearing a call is analogous to hanging up a telephone receiver in a circuit switched network. When you clear a call, the virtual circuit with the remote DTE is broken. You must place another call to reestablish data transfer. When you have finished your communications with the remote DTE and want to clear the call, complete the following steps:

1) After finishing your session with the remote DTE, complete your normal logoff procedures. When you log off, the remote DTE may automatically clear the call and place you in command mode. If you are using the control channel and enter the Exit Configuration selection from the PAD main menu, the call is also cleared. In either case, the following appears on your screen:

```
CLR CAUSE: DTE ORIGINATED
*
```

If the above message does not appear, proceed to Step 2.

2) If a call clearing message did not appear in Step 1, enter the PAD recall character (factory default = @) to enter the command mode. After you enter the recall character (which is not displayed on your screen), data transfer is suspended, your terminal shifts to command mode, and the PAD responds with an asterisk:

```
*
```

3) To clear the call while in the command mode, enter the following command after the asterisk:

```
CLR
```

4) After you have completed Step 3, the PAD displays a "call cleared" confirmation on your screen as shown below.

```
CLR CONF
*
```

You have now cleared your virtual call and disconnected the virtual circuit. You can place another call (see Step 2 under "Placing Calls") or enter other commands as described in the following section.

COMMAND MODE

Use the command mode to quickly reconfigure XL PAD parameters or check X.25 network status, even if you are in the middle of data transfer. Detailed PAD configuration and diagnostics are primarily accomplished through the XL PAD control channel, but the command mode is particulary useful if you want to change just a few operating parameters for a terminal. You can use the command mode prior to placing a virtual call, or after a virtual circuit has been established.

Accessing the Command Mode

Any time the PAD prompt character (*) is displayed on your screen, your terminal is in the command mode. You can access the command mode in three ways:

- If you do not have auto call enabled, power on your local terminal and press ⟨CR⟩ several times until the prompt character (*) appears.
- If your terminal is in the data transfer mode, enter the PAD recall character. (The factory default PAD recall character is @.) The recall character does not appear on your screen after you key it in. Instead, the prompt character (*) is displayed.
- If you have finished a data transfer session with a remote DTE and you log off as usual to end the session, the remote DTE or PAD may automatically clear the call and place you in command mode. This will also happen if you are using the XL PAD control channel and you enter the Exit Configuration selection from the PAD main menu.

■ **Note:** If you leave the data transfer mode by entering the PAD recall character (factory default = @), it is not necessary to place another call to return to the data transfer mode provided the current call is not cleared. When an asterisk (*) is not displayed after you enter a command, you are in the data transfer mode and may communicate with the remote DTE or enter another command by keying in the PAD recall character again.

Commands

CCITT standards X.28 and X.29 specify PAD commands and describe command functions. The commands used in the XL PAD follow the guidelines in the 1984 X.28 and X.29 recommendations, except the XL PAD does not support the X.29 command "Reselection." The XL PAD does, however, offer several additional commands not specified by the X.28 and X.29 recommendations. For more detailed descriptions of some X.28 and X.29 commands used in the XL PAD, refer to the corresponding CCITT standards. *When using the command mode in the XL PAD, however, make sure to consult the XL PAD command descriptions and the instructions for their use found in this chapter.*

When the command prompt (*) is on your screen, you can enter the XL PAD commands described in the remainder of this chapter. You can enter the commands in upper- or lower-case letters, or a combination of the two. Although each command has at least three characters, you can enter an abbreviated form of each command by entering only the underscored characters in the following descriptions. Do *not* enter the underscore characters themselves.
■ **Note:** A control character cannot be the start of a valid command. If local echo is enabled, control characters are ignored and not echoed until at least one alphabetic character is typed.

CALL. Use this command to initiate a virtual call to a remote DTE. The following example shows how the CALL command can be used to call a remote DTE using the X.121 network address of the remote DTE:

```
CALL 617555678901
```

After your entry, the local XL PAD will send a call request packet to the remote DTE containing the called address you entered after the CALL command. If the remote DTE accepts the call, it will return a call accepted packet and the virtual circuit is established.

You can also use the CALL command to call a remote DTE with a mnemonic address you have set up using the control channel. See the following example:

```
CALL BOSTON
```

To repeat a call to the DTE address specified after a previous CALL command, you need only enter the CALL command. Assuming the last address called was BOSTON, as in the preceding example, you could place another virtual call to BOSTON by entering:

```
CALL
```

If you want to change an existing call address, enter the CALL command and a new call address:

```
CALL 89
```

To display the address last used with the CALL command, enter the CALL command followed by a space and question mark (see below).

```
CALL ?
```

In addition to the address, some networks use a portion of the user data field of call request packets to supply further routing information. The user data pattern you enter is included in the first sixteen bytes of the user data field of call request packets generated by the CALL command. To send additional data, you must add a suffix to the CALL command, followed by the data you want to include in the user data field of the call request packet. You must enter the data in hex and/or ASCII form. Double quotes must enclose ASCII characters in your entry, but are not part of the data pattern. For example: "USER DATA" might be entered as your user data pattern, which would be equivalent to 5553455220444415441 in hexadecimal form.

You can include up to 16 bytes of data in the call request packet generated by the CALL command. To send additional data, you must add a suffix to the CALL command followed by the data you want to include in the user data field of the call request packet. This added information may be additional subaddressing, a brief message identifying the caller, or a logon password. If the data is additional addressing information or a message, use the suffix *D combined with the CALL command, as in the following example:

```
CALL BOSTON *D "USER DATA"
or
CALL BOSTON *D5553455220444415441
```

When you use the *D suffix as in the above example, your example is displayed on your async terminal as you key it in. If you want to send a password or other confidential information, however, use the suffix *P as in the following example. The information shown in italics is not displayed on the local terminal as you key it in.

```
CALL BOSTON *P "PSW_7125"
```

When the user data has been defined placing a call with *D or *P suffix, then the data is always sent even if *D or *P is not included in the CALL command. To clear a previously defined user data field, enter *D or *P with no user data after it as in the example below:

```
CALL BOSTON *D
```

CLR. This command clears a virtual circuit by generating a clear request packet to the remote DTE. If you enter the CLR command when a virtual circuit has not been established, an error message will appear on your screen. ■ **Note:** When you enter the CLR or RESET commands, a Clear or Reset request packet is generated to the network. If the XL PAD does not receive a Clear Confirmation or Reset Confirmation packet in response to the corresponding command, the XL PAD retries the request packet after a 180-second waiting period. If the remote DTE still has not responded after 180 seconds, the XL PAD performs the Reset or Clear procedure without the acknowledging packet, and displays the Clear or Reset Indication message on your screen if NOCNFOK is enabled as a Packet Level Option.

FACILITIES. The XL PAD offers some special features (facilities) described in CCITT recommendations X.2 and X.25. The complete list of facilities described in the recommendations is quite extensive, but the facilities available to you will vary according to the X.25-compatible equipment you use in your network. Use the FACILITIES command to request features in a call request packet and to specify the variables for those features, if any.

When you want to set up the facilities that will be in effect for a given call, be sure to enter the desired FACILITIES command and codes before you place a call that requires the facilities. The following is an example of a FACILITIES command combined with the facility codes and values for packet and window size. (For a more detailed description of packet and window size negotiation, see the Auto Call Facilities section of the Enable Auto Call menu as described in Chapter 3.)

```
F 420505430707
```

The value displayed after the command above is a string of facility codes/settings for each of two facilities. Several facilities can be requested by running facility codes and settings together. If you want to display the facilities currently in effect, enter:

```
FACILITIES
```

If you want to recall the default facilities for the XL PAD at any time, enter an asterisk after the command as in the following example:

```
F *
```

FULL. Enter this command to establish full-duplex communications between the PAD and your terminal. Full-duplex is the default setting for most profiles; if you enter the FULL command when full-duplex has already been enabled, the FULL command has no effect. Enter the PAD recall character (factory default = @) to continue entering commands.

HALF. Enter this command to establish half-duplex communications between the XL PAD and your terminal and to specify which characters should or should not be echoed. In most half-duplex applications, most characters are not echoed; however, disabling X.3 parameter reference number 2 (Echo) is not the same as entering the HALF command. The HALF command is offered in the XL PAD to accommodate the following functions that are not accommodated by merely disabling the X.3 Echo parameter:

- Line folding
- Tab expansion
- Linefeed insertion
- Carriage return ⟨CR⟩ and line feed ⟨LF⟩ padding
- Destructive character and line deletion

If you are using the terminal for an interactive application and the terminal requires any of the above functions, you should enter the HALF command. If your application involves a file transfer, do not enter the HALF command; disable the X.3 Echo parameter instead. If you choose to enter the HALF command and also enable the X.3 Echo parameter, X.3 parameter reference number 20 (Echo Mask) is overridden and ignored.

To set up half-duplex operation between your terminal and the XL PAD, enter:

```
HALF
```

If you want characters echoed while operating in half-duplex, enter the decimal number(s) of the ASCII characters to be echoed as in the following:

```
HALF 13,10,9
```

Always insert a comma between character numbers if you want more than one echoed. If you want to prevent a previously selected character from being echoed, enter a minus (–) prior to the appropriate character and after the command:

```
HALF – 9
```

If you want to delete all the characters you previously selected to be echoed, enter an asterisk character after the command as in the following:

```
HALF *
```

HELP. Enter this command to display a list of all the XL PAD commands on your screen. A list of these commands is also provided for your reference in Chapter 7.

INTERRUPT. You must have a virtual circuit established with the remote DTE prior to entering this command. Use this command to generate an interrupt request packet to the remote DTE. You may wish to use this command if the remote DTE refuses to acknowledge packets you have sent. Sending an interrupt packet will prompt an immediate confirmation from the remote DTE regardless of the current packet sequence. If you do not receive a confirmation from the remote end, there is a problem with the network itself. To send an interrupt request packet, enter:

```
I
```

LISTEN. Enter the LISTEN command to determine the listen address type and pattern for the port your terminal is connected to. The listen field and pattern have the same general descriptions as the Default Listen Type and Default Listen Pattern described in Chapter 3, but the address type and pattern you key in following the LISTEN command take precedence over the default settings accessed through the control channel.

Following your command, the XL PAD will "listen" for the address you specify in call request packets coming into the PAD from the network. If a call request packet has a called address that matches the listen type and pattern you specified, a virtual circuit is established. In the following example, the listen pattern is 02 and the XL PAD has been commanded to listen to the address field to recognize the listen pattern:

```
LISTEN ADDR=02
```

If your network does not support subaddressing in the address field of packets, you can command the XL PAD to match your listen address pattern to the user data field of call request packets coming in from the network:

```
LISTEN DATA=02
```

PAR. Enter the PAR command to display X.3 parameters currently in effect for the terminal you are using. You can enter:

```
PAR?
```

to display all the X.3 parameters, or enter the command followed by specific parameter numbers to display selected parameters. As an example:

```
PA 13,14,19
```

will display the parameter numbers and their current values for parameters 13, 14, and 19 on your screen.

PROF. Use this command to display the X.3 parameter profile currently in effect for the port you are using by entering:

```
PROF
```

To display the current profile in effect followed by a list of available permanent and user profiles, enter the following, making sure to insert a space between the PROF command and the question mark:

```
PROF ?
```

To select or change a profile for the port you are using, enter the PROF command followed by the desired profile. You might enter the following if you are using a standard async CRT:

```
PR CRT
```

RESET. You must have a virtual circuit established with the remote DTE prior to entering this command. Enter the RESET command to generate a reset request packet to the remote DTE. ■ **Note:** Use this command with caution: Entering RESET may cause undelivered packets in the network to be discarded.

When the reset request packet is sent, the remote DTE issues a reset confirmation and the packet sequencing mechanism in your local XL PAD is reset to zero. The RESET command is more disruptive than the INTERRUPT command, but unlike the CLR command it does not break the virtual circuit. ■ **Note:** When you enter the CLR or RESET commands, a Clear or Reset request packet is generated to the network. If the XL PAD does not receive a Clear Indication or Reset Indication packet in response to the corresponding command, the XL PAD retries request packets twice during a 180-second time period. If the remote DTE still has not responded after 180 seconds, the XL PAD performs the Reset or Clear procedure without the acknowledging packet, and displays the Clear or Reset Indication message on your screen if NOCNFOK is enabled as a Packet Level Option.

SET. Enter SET followed by an X.3 parameter reference number and value to change parameter values selectively. When using the SET or SET? commands, the changed X.3 parameters are in effect until a call is placed and cleared. When the call is cleared the parameters return to the initial value. If you wanted to set or change the values for the linefeed insertion and character delete parameters, you might enter:

```
SE 13:5, 16:8
```

If you would like the new parameter reference numbers and values displayed after you set them, see the next command.

SET?

Use this command to set a parameter to a new value and then display the results of your changes. Using the SET? command rather than SET provides you with a confirmation that your parameter value changes have actually taken effect by redisplaying them. If you set parameter values as in the following example:

```
SET? 13:5, 16:8
```

The XL PAD redisplays the new parameter values to confirm the change.

STATUS. Enter the STATUS command to display a brief status of the virtual circuit, the baud rate for the port you are using, the async port number you are currently using, the status of the X.25 physical link, and the status of frame and packet levels. ■ **Note:** If no data is being exchanged and/or the cable is disconnected at the 2600 (without XL PAD) remote site, then the frame and packet level status does not change to indicate that the network is down. If the remote site is powered off, then frame and physical link reflect that it is down.

If you enter:

```
S
```

The pad might return a confirmation of:

```
FREE: 9600 BAUD/PORT#1/PLNK UP/FRM UP/PKT UP
```

This indicates that no virtual circuit is established yet, the baud rate has been set at 9600, you are currently using port 1, the X.25 physical link is up, and the frame and packet levels are up. If you place a virtual call and issue the STATUS command again, the display might read:

```
  CALLING: 9600 BAUD/PORT#1/PLNK UP/FRM UP/PKT UP
 OUTGOING: CLD_ADDR 123/CLG_ADDR 123
      FAC: 4302020420707
    UDATA: My user data
```

If clearing a call, the display might read:

```
 CLEARING: 9600 BAUD/PORT#1/PLNK UP/FRM UP/PKT UP
 INCOMING: CLD_ADDR 123/CLG_ADDR 123
      FAC: 4302020420707
    UDATA: My user data
```

Once the virtual circuit has been established with a remote DTE, the STATUS command would cause a display similar to the following:

```
 ENGAGED: 9600 BAUD/LC#11/PORT#1/PLNK UP/FRM UP/PKT UP
INCOMING: CLD_ADDR 123/CLG_ADDR 123
     FAC: 4302020420707
   UDATA: My user data
```

This display would mean that the port is running at 9600 baud, a virtual circuit is established for port #1 on logical channel #11, X.25 physical link is up, and communications are established at the frame and packet levels. The status of PLNK, FRM, and PKT can be either UP or DN. A call can be either incoming or outgoing.

The fields in this display have the following meanings:

- CLD ADDR is the called address. It may be up to 15 digits long. The calling address is displayed only if CALLING ADDRESS INSERTION is enabled. This selection is located in the X.25 PARAMETERS (1.1.1) menu of the control channel.
- CLG ADDR is the calling address. It may be up to 15 digits long. The calling address is displayed after CLG_ADDR only if calling address is present in the call request packet.
- OUTGOING is the call direction. The addresses that follow OUTGOING are inserted in the call request packet sent out to the network. CLD_ADDR is the address in the network being called and CLG_ADDR is where the call was made from.
- INCOMING is the call direction. The addresses that follow INCOMING are from the call request packet coming in from the network. CLD_ADDR is your network address and CLG_ADDR is where the network call came from.
- FAC is the facilities field of the call request packet. This field may be up to 63 hexadecimal digits long. The facilities field is displayed after FAC only if facility negotiations are present in the call request packet.
- UDATA is the user data field of the call request packet. The data length depends on the direction of the call. The user data field is up to 16 bytes long of intermixed hexadecimal digits and/or ASCII characters if the call is outgoing. If the call is incoming, the user data field is up to 12 ASCII characters long. This is because the first four bytes of the call user field are used for the protocol ID field. For example, if an outgoing call's user data field is specified as 01000000 "My user data," that is what appears as the user data field at the terminal sending out the call. "My user data" appears as the user data field at the terminal receiving the call. The user data appears after UDATA only if user data is present in the call request packet.

If you send or receive a call request packet which does not contain the FAC or UDATA fields, the data after these identifiers is left blank.

TABS. Use this command in combination with the EXP suffix described below to control how the local XL PAD will replace tab characters it receives from the local terminal with the appropriate number of spaces. This process is called tab expansion. To enable tab expansion, enter the following:

```
TABS EXP 1
```

A setting of 0 following the EXP portion of the above command would disable local tab expansion.

The TABS command can be combined with two other suffixes besides the EXP suffix: these suffixes tell the XL PAD where to set tab stops for the local (LCL) and remote (REM) DTEs. When entering LCL, you might specify that the XL PAD should set a tab stop at every fifth column as in the following example:

```
TAB LCL 5 EXP 1
```

In the preceding case, the XL PAD would set tab stops at every fifth column and enable tab expansion for tab characters echoed to the local terminal or forwarded by the PAD from the network to the local terminal. If you want to expand tabs the XL PAD forwards from the local terminal to the network, you may do so by entering a command similar to the following:

```
TABS REM 5
```

In the case where the local terminal must expand tabs on its own, enter 0 (disable) following the EXP suffix. If you disable local tab expansion, however, and still wish to retain line folding, character deletion, and line deletion features, you must set the local terminal's tab stops to match those of the XL PAD. See the following for an example of a command used to match the local terminal's tab settings at every eighth column:

```
TABS LCL 8 EXP 0
```

To disable tab expansion entirely, enter zeros after all the command segments as follows:

```
TABS LCL 0 REM 0 EXP 0
```

Note that the LCL, REM, and EXP suffixes can be entered in any order or selectively, but must be entered in combination with the TABS command. To change a preexisting value for LCL, REM, or EXP, enter the suffix followed by a new value.To access the following commands, you must have the X.29 options set.

RPAR. Use this to send a Read PAD Command to the remote PAD. The syntax is the same as the PAR? command. The command appears only if RCMDS (remote commands) is selected for the port under X.28 Per Port Options. The X.28 Per Port Options default is NONE.

RPROF. This command takes a profile name as a parameter, looks it up in the profile tables on the ''local'' PAD, and converts the profile's X.3 settings into a Set and Read PAD Command. The X.3 parameter settings of the affected remote PAD port changes, but its profile stays the same. The command appears only if RCMDS (remote commands) is selected for the port under X.28 Per Port Options. The X.28 Per Port Options default is NONE.

RSET. Enter RSET to send a Set PAD Command. The syntax is the same as the SET Command. The command appears only if RCMDS (remote commands) is selected for the port under X.28 Per Port Options. The X.28 Per Port Options default is NONE.

If you want to send a Set and Read PAD Command, see the next command.

```
RSET?
```

RICLR. Enter RICLR to send an Invitation to Clear PAD Command. The syntax is the same as the CLR command. This command appears only if RCMDS (remote commands) is selected for the port under X.28 Per Port Options. The X.28 Per Port Options default is NONE.

THE INCOMING CALL DISPLAY

When you have set up your X.25 network as shown in any of the examples in Chapter 2, you may begin to receive calls from the remote DTE. The following is an example of the text that is displayed on your local terminal to indicate an incoming call.

```
INCOMING CALL:   03    003    430202420707 BOSTON
```

The four fields in this display have the following meanings:

- The phrase INCOMING CALL indicates a call request packet has been received from the remote DTE.
- The second field with the code 03 in the above example tells you that the incoming call request packet has a called address of 03, which means async port 3 in the XL PAD's default address scheme.
- The third field in the display is the calling address of the remote DTE; in this case, the address of the remote DTE is 003.
- The fourth field of the incoming call display shows the facilities that have been negotiated for the incoming call. In the example shown above, the facilities are packet size (42) and window size (43) with the accompanying settings that have been determined for each.
- The fifth field of the incoming call display shows the user data that was sent with the incoming call. In the example shown above, the user data is BOSTON. The first four bytes (characters) are not displayed as they are assumed to be a protocol identification field. In the above example, actual user data is 01000000 BOSTON or 01000000 424F53544F4E, where the protocol identification field is CCITT (01000000). This field is displayed only if there is user data in the incoming call request packet.

Chapter 6
PAD Diagnostics

Contents

General 6-1
Self Test 6-3
Status 6-4
  X.25 Network 6-5
  Async Port Status 6-6
  Software Release Date 6-7
  System Status 6-7
Performance Statistics 6-8
  View X.25 Statistics 6-8
  View Async Statistics 6-9
  Clear X.25 Statistics 6-11
  Clear Async Statistics 6-11
  Clear All Statistics 6-12
  View System Statistics 6-12
  Clear System Statistics 6-12
  View Broadcast Statistics 6-12
  Clear Broadcast Statistics 6-13
Diagnostics 6-13
  Packet Level Probe 6-13
  Packet Level Trace 6-13
X.25 Cause Codes and Diagnostic Codes 6-14

GENERAL

In addition to the 2600 Series Status and Test trees accessed from the modem front panel, the XL PAD control channel offers status and performance statistics specific to XL PAD operation. Use this diagnostic information to find out:

- The quantity and types of frames and packets being sent and received at the XL PAD.
- How many packets with errors have been received by the XL PAD.

- Virtual call progress between the XL PAD and remote terminals.
- Whether a terminal is in the data transfer or command mode.

This chapter describes how to access the XL PAD status and statistics, but begins by explaining how the standard 2600 Series Modem Status and Test trees have changed with the installation of the XL PAD.

The main difference in front panel operation of the 2600 Series Modem with the PAD is in the Test tree. You cannot perform loopback, poll, or BER tests on ports you have selected for X.25 operation in the PAD-equipped modem. Differences in the Test tree are summarized in the following section:

Local (2600 XL PAD) Front Panel Operation

- LOOPBCK. Perform digital loopback and terminal loopback only on TDM ports 1 and 2 (modem channels 2 and 3, respectively).
- POLL. Perform POLL test only if bandwidth is allocated to channel 1 (network port). If the remote 2600 Modem is not equipped with the XL PAD, the XL PAD's network corresponds to the 2600's port 1 (if the 2600 is configured correctly with a one-to-one port/channel map). ■ **Note:** The POLL test disrupts traffic on the network port and therefore disrupts the X.25 protocol.
- BER. Perform BER on the network port, TDM port 1, and TDM port 2, if bandwidth is allocated to the corresponding channel. If the remote modem is a 2600 without the XL PAD, the PAD's network port and TDM ports 1 and 2 correspond to the 2600 port's 1, 2, and 3, respectively (if the 2600 is configured correctly with a one-to-one port/channel map).
- SELF. The TIME subcategory is not displayed because continuous self test is not supported. TESTING is displayed while self test is running. CLR DTX is displayed when test is complete and the 2600 XL PAD recovers from self test. PASSED or FAILED is then displayed to reflect the self test result.
- SLF RES. DTX card self test results are reported as DTX PASS or DTX FAIL.

Remote (2600 XL PAD-to-2600 XL PAD) Front Panel Operation

- LOOPBCK. Perform digital loopback and terminal loopback only on TDM ports 1 and 2 (modem channels 2 and 3, respectively).
- POLL. Perform POLL test only if bandwidth is allocated to channel 1 (network port). ■ **Note:** The POLL test disrupts traffic on the network port and therefore disrupts the X.25 protocol.
- BER. Perform BER on the network port, TDM port 1, and TDM port 2, if bandwidth is allocated to the corresponding channel.
- SELF. The TIME subcategory is not displayed because continuous self test is not supported. TESTING is displayed while self test is running. CLR DTX is displayed when test is complete and the 2600 XL PAD recovers from self test. PASSED or FAILED is then displayed to reflect the self test result.
- SLF RES. DTX card self test results are reported as DTX PASS or DTX FAIL.

Remote (2600 XL PAD-to-2600) Front Panel Operation

- LOOPBCK. Perform digital loopback only on TDM ports 2 and 3 (modem channels 2 and 3) of the 2600. Perform terminal loopback only on TDM ports 2 and 3 (modem channels 2 and 3) of the 2600.
- POLL. The POLL test is not a remote front panel operation. If you select POLL test while a remote front panel connection is established, the test is initiated from the master, not the slave. The 2600 XL PAD's network port corresponds to the 2600's port 1 (if the 2600 is configured correctly with a one-to-one port/channel map).
- BER. The BER test is not a remote front panel operation. The 2600 XL PAD's network port and ports 1 and 2 correspond to the 2600's port 1, 2, and 3, respectively (if the 2600 is configured correctly with a one-to-one port/channel map). If you select BER while a remote front panel connection is established, the test is initiated from the master, not the slave.
- SLF RES. The DTE card self test results are reported as DTE PASS or DTE FAIL.

Remote (2600-to-2600 XL PAD) Front Panel Operation

- LOOPBCK. Perform digital loopback only on TDM ports 1 and 2 (modem channels 2 and 3) of the 2600 XL PAD. Perform terminal loopback only on TDM ports 1 and 2 (modem channels 2 and 3) of the 2600 XL PAD.
- POLL. The POLL test is not a remote front panel operation. If you select a POLL test while a remote front panel connection is established, the test is initiated from the master, not the slave.
- BER. The BER test is not a remote front panel operation. When you run a BER test from a 2600 to a 2600 XL PAD, the 2600 ports 1, 2, and 3 correspond to the 2600 XL PAD's network port, port 1, and port 2, respectively. If you select BER while a remote front panel connection is established, the test is initiated from the master, not the slave.
- SLF RES. DTX card self test results are reported as DTE PASS or DTE FAIL.

SELF TEST

Each time you power-up the XL PAD, or enter START under the SELF* category, an internal self test is performed. If there is an internal problem with the XL PAD, a failure message is displayed on the front panel and a power up alarm is generated. In addition, if you perform the SELF✳ test from the modem front panel after power-up, messages related to DTX card operation can appear.

For a detailed description of a failure message, you can view specific modem diagnostic codes in the DIAGNOS✳ category of the Status tree. When using the *2600 Series Modem User's Manual* to interpret the results from the diagnostics category, remember that card code 02 now refers to the DTX card (where the XL PAD hardware and software resides) rather than the DTE card. See Table 6-1 for the diagnostic codes that have been added to the modem along with the XL PAD option. These codes are intended to be used by trained service personnel for isolation of internal problems in the XL PAD circuitry.

Table 6-1.
XL PAD Diagnostics Codes

Card Code	*Failure Code*	*Diagnostic Message*	*Suspected Area*	*Definition*
Power-up				
02	028	DTE_RM_F	DTX Card	Dual Port RAM failure; DP detected
02	081	DRAM_1_F	DTX Card	Dynamic RAM Pass 1 Failure
02	082	DTX_PF_1	DTX Card	DTX PROM Checksum 1 Error
02	082	DTX_PF_2	DTX Card	DTX PROM Checksum 2 Error
02	083	DPRAM__F	DTX Card	Dual Port RAM Failure; DTX detected
02	084	DRAM_2_F	DTX Card	Dynamic RAM Pass 2 Failure
Online				
02	023	—	DTX Card	Dual Port RAM queue overflow
02	024	—	DTX Card	SCC self test failure
02	025	—	DTX Card	XPC self test failure
02	026	—	DTX Card	DTX watchdog timeout-system reboot
02	027	—	DTX Card	DTX Dynamic RAM parity error

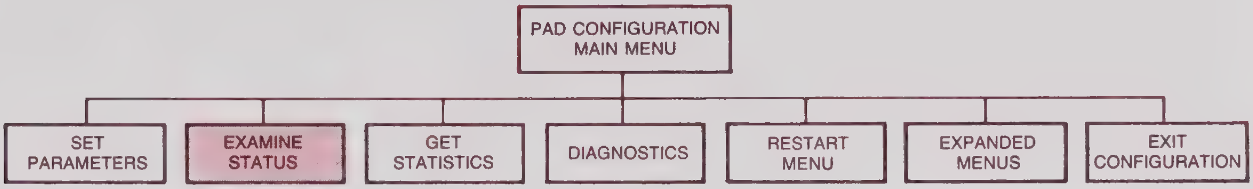
STATUS

The Status✳ tree accessed with the modem front panel and described in the *2600 Series Modem User's Manual* changes sometimes with the XL PAD Option installed. The differences are as follows:

- In local (2600 XL PAD) and remote (2600 XL PAD-to-2600 XL PAD) front panel operation, the GENERAL category displays rates for the network port, TDM port 1, and TDM port 2 (modem channels 1, 2, and 3, respectively).
- In remote (2600 XL PAD-to-2600) front panel operation, the GENERAL category displays rates for all ports on the 2600.
- In remote (2600-to-2600 XL PAD) front panel operation, the GENERAL category displays rates for 2600 XL PAD ports 1 to 4. The rates for 2600 ports 1, 2, and 3 correspond to the 2600 XL PAD's TDM port 1, TDM port 2, and the network port, respectively. The rate for port 4 is zero.

The XL PAD makes additional X.25 and async port status information available through the XL PAD's control channel. This section describes how to access the EXAMINE STATUS menu and explains the menu selections in their order of appearance in the menu.

To access the EXAMINE STATUS menu with the control channel, place a virtual call to the control channel by following the procedure described in Chapter 3. See the illustration on the following page for the location of the EXAMINE STATUS menu in relation to the other selections in the PAD MAIN MENU.



When the PAD MAIN MENU appears on your screen, enter selection 2 to display the EXAMINE STATUS menu as it appears below (selection 4 appears in Expanded Menus only):

```
EXAMINE STATUS (1.2)
1) X.25 status
2) Async port status
3) Software release date
4) System status
Enter number (X to exit):
```

X.25 Network

Enter 1 from the EXAMINE STATUS menu to display the X.25 status of the XL PAD. When you make the selection, the packet, frame level, and physical link (modem) states are displayed as in the following example:

```
X.25 STATUS (1.2)
Packet Level: PAD restarting
Frame Level: Sending SABM
Physical Link: DN
```

If you are having trouble establishing virtual circuits, you can view the packet and frame level and physical link status of the XL PAD to isolate problems. In the above example, the XL PAD is sending a SABM (set asynchronous balanced mode) frame, the packet level is in the "restarting" state, and the physical link is down.

All of the possible packet and frame level and physical link status indicators are listed and described in the next two sections.

Packet Level. The status of the packet level of communications between the local XL PAD and the remote DTEs is described by the following indicators:

- UP. The packet level is functioning normally and the XL PAD can accept virtual calls.
- DOWN. The packet level cannot support a virtual circuit.
- PAD RESTARTING. A restart request packet has been issued from the XL PAD.
- NET RESTARTING. A restart request packet has been received from the network.
- RESTARTING. The XL PAD and/or network are restarting.
- INITIAL (AWAITING RESTART). The XL PAD is awaiting a restart from the network before making the transition to the UP state.

Frame Level. The status of the frame level between the local XL PAD and the remote DCE is described by the following indicators:

- UP. The frame level is functioning normally and the XL PAD can accept virtual calls if the packet level is also in the UP state.
- DOWN. The frame level cannot pass HDLC traffic.
- SENDING SABM. The XL PAD is sending a Set Asynchronous Balanced Mode frame to the DCE.
- SENDING DISC. The XL PAD is sending a Disconnect frame to the DCE.
- SENDING FRMR. The XL PAD is sending a Reject frame to the DCE.

Physical Level. The status of the local and remote modem physical connection as described by the following indicators:

- UP. The physical connection is functioning normally and and the XL PAD can accept virtual calls if the frame and packet levels are also up.
- DN. The physical connection cannot support data traffic.

Async Port Status

Enter 2 from the EXAMINE STATUS menu to check the general status of each async port. The XL PAD prompts you to select a port number and then displays the status information for the port you select. The following example shows the status items and some of their possible states as they appear on your screen:

```
terminal handler: CMD
terminal i/o: IDLE
pad message: ACCEPTING
virtual call: FREE
async device: DISCONNECTED

RTS     CTS     DSR     DTR     DCD
-       +       +       -       +

X.3 PARAMS:
1:0, 2:0, 3:0, 4:0, 5:0, 6:0, 7:0, 8:0, 9:0, 10:0, 11:0, 12:0, 13:0,
14:0, 15:0, 16:0, 17:0, 18:0, 19:0, 20:0, 21:0, 22:0
EXTRA PARAMS: LCL 0, REM 0, EXP 0, HDX 0
```

The following section describes the async port status headers and the possible values for each.

Terminal Handler. Shows whether the async port you entered is in the data transfer (DATA) or command mode (CMD). In addition, the terminal can also be waiting for the command mode (WTG FOR CMD); this terminal handler condition occurs when you have keyed in the PAD recall character to leave the data transfer mode, but have not yet begun to enter a command.

Terminal I/O. Describes the flow of data between the XL PAD and a terminal, using the XL PAD as a reference point. The terminal can be in one of three states:

- IDLE. The terminal on the port you entered is not sending or receiving data.
- INPUT. The terminal is sending data to the XL PAD.
- OUTPUT. The XL PAD is sending data to the terminal.

Pad Message. Indicates whether the XL PAD is ACCEPTING X.29 command values or DISCARDING them. The XL PAD normally accepts X.29 commands.

Virtual Call. Describes the progress of virtual calls placed from the async port. One of the following values is displayed:

- FREE. The port you selected does not have an ongoing virtual call to the remote end, but is ready for a call to be placed.
- CALLING. Signifies a call request packet has been sent to the remote DTE, but the call has not yet been accepted.
- ENGAGED. The virtual call has been accepted and the terminal has a virtual circuit established with the remote end. If the value is ENGAGE, the following information is displayed:

  ```
  VIRTUAL CALL: ENGAGED, CONTROL SESSION #2
  OUTGOING: CLD_ADDR- /CLG_ADDR-
  ```

  or

  ```
  VIRTUAL CALL: ENGAGED, LOGICAL CHANNEL #2
  INCOMING: CLD_ADDR- /CLG_ADDR-
  ```

  CONTROL SESSION #2 is a session established on logical channel #2 for a local call to the control terminal port. OUTGOING is a call from the XL PAD to the network. CLD_ADDR displays the call address field of call request packets. CLG_ADDR displays the calling address field of call request packets. LOGICAL CHANNEL #2 is the logical channel number the port is currently using. INCOMING is a call from the network to the XL PAD.
- CLEARING. The virtual call is being cleared. Under normal conditions, a port is only briefly in this state.

Async Device. This header describes how the terminal is communicating with the local XL PAD. The possible values are:

- DISCONNECTED. The terminal is disconnected from the XL PAD because you have enabled async device mode KILL for the port, or because the async device has not raised the appropriate EIA signals dictated by the async device mode.
- CONNECT WTG. The XL PAD is waiting for the async device to raise the EIA signals required for logical connection to the XL PAD, as specified by the async device mode you have enabled for the async device.
- SPEED SENSE. The XL PAD is attempting to determine the baud rate of the async device by examining the bit stream being transmitted from the device.
- DISC WTG. The XL PAD is waiting for the async device to drop the EIA signals required to disconnect the device, as determined by the async device mode you have enabled.
- PARITY SENSE. The XL PAD will determine the async device's parity to be even or odd when the PAD receives the next character from the device.
- SPEED CHECK. The XL PAD has sensed the async device's speed and is now searching for the next CR character, which the PAD will use to verify the speed before the PAD ''locks'' on the sensed speed.
- COMMUNICATING. The terminal is logically connected to the XL PAD; the EIA signals required by the selected async device mode have been raised and SPEED SENSE, PARITY SENSE, and SPEED CHECK have been performed by the PAD if they are required by the selected async device mode.

EIA Status Indicators. The plus and minus signs indicate whether the EIA signal shown is on or off. You can view the same information by using the modem's front panel to enter the Port Select category of the Status tree, and then observing the EIA LEDs on the modem front panel. The front panel indicators, however, monitor continuously, while the EIA indicators in the XL PAD's control channel show the EIA signal states at the instant after you enter the Async Port Status selection.

X.3 Parameters, Extra Parameters. The numbers shown are the X.3 parameter reference numbers and values currently in effect, followed by the extra XL PAD parameters and their current values. See the section titled ''X.3 Parameter Guide'' in Chapter 7 for a complete description of the parameters.

Software Release Date

Select 3 from the EXAMINE STATUS menu to display the title and manufacturing release date of the XL PAD software you are using. You will see a display similar to the one below:

```
GCOM RSYS(TM) PAD version of 07/10/87
```

System Status

The System Status selection appears only in Expanded Menus.

Enter 4 from the EXAMINE STATUS menu to check the status of large and small buffers, memory, and the number of buffers queued to and from the network. When you make the selection, the above information is displayed as in the following example:

```
SYSTEM STATUS:

BUFFERS:          Total    In-Use    Free
    Large:          571         6     565
    Small:          100         2      98

MEMORY:          381080    374384    6696

QUEUED BUFFER COUNTS:

Direction     Type                     # Buffers Queued
FROM NET      ASYNC ISR OUTPUT                0
FROM NET      PAD MODULE OUTPUT               0
FROM NET      PAD MESSAGE                     0

TO NET        FRAME LEVEL                     0
TO NET        PACKET LEVEL                    0
TO NET        PAD MODULE ECHO                 0
TO NET        ASYNC ISR ECHO                  0
```

Buffers. The buffer status indicates the total number of large and small buffers available, the current number in use, and the current number free.

Memory. Memory status is the size of memory reserved for buffers, the current amount allocated for large and small buffers, and the amount not allocated from the total reserved memory.

Queued Buffer Counts. The buffered queued count displays the status of buffers to be processed to and from the network. The different types of buffered queued counts are as follows:

- ASYNC ISR. The async ISR (Interrupt Service Routine) is the async device connection and indicates that buffers are waiting to be processed to or from the async device(s).
- PAD MODULE. This is the logical connection and indicates that buffers are waiting to be processed to or from the async device connection(s).
- PAD MESSAGE. This indicates the number of Q bit messages (control information) waiting to be processed.
- FRAME LEVEL. Indicates the number of buffers waiting to be processed to the network at the frame level.
- PACKET LEVEL. Indicates the number of buffers waiting to be processed to the network at the packet level.

PERFORMANCE STATISTICS

You can examine statistics indicating XL PAD performance by selecting 3 from the PAD CONFIGURATION MAIN MENU. The GET STATISTICS menu gives you the following choices (selections 6 through 9 appear only in Expanded Menus):

```
GET STATISTICS (1.3)
1) View X.25 statistics
2) View async statistics
3) Clear X.25 statistics
4) Clear async statistics
5) Clear all statistics
6) View system statistics
7) Clear system statistics
8) View broadcast statistics
9) Clear broadcast statistics
Enter number (X to exit):
```

■ **Note:** When you want to clear statistics, they will be reset to zero immediately upon your selection of choices 3, 4, 5, 7, or 9. If you enter selection 4, the XL PAD prompts you to select a specific port or all ports, and then resets the statistics to zero immediately after your selection. Ensure that you want to clear statistics when entering these selections so that you do not lose the previously recorded statistics inadvertently.

View X.25 Statistics

Select 1 from the GET STATISTICS menu to view the frame and packet level X.25 statistics. These statistics show the types and total quantities of packets and frames sent and received by the XL PAD. After you enter 1, a display similar to the following appears:

```
X.25 STATISTICS:

FRAME LEVEL STATISTICS
  I-Frames   T1    Aborts    Overruns    Idle-Line
Snd:  0       0
Rcv:  0       0      0          0            0

           REJ     CRC-Errors     FRMR
Snd:                               0
Rcv:        0          0           0

PACKET LEVEL STATISTICS
           Data          Intr        RR         RNR
Snd:        0             0          0           0
Rcv:        0             0          0           0

           Reset    Call    Clear    Restart    Invalid
Snd:         0       0        0         0
Rcv:         0       0        0         0          0
```

Frame Level Statistics. Frame level statistics detail the number of Information frames (I-Frames) and T1 timer expirations (T1) that the XL PAD has sent to and received from the network since the X.25 statistics were last cleared. Other statistics include the number of aborted frames (ABORTS), overruns, and idle line occurrences (IDLE LINE). Also shown are the reject frames (REJ), cyclic redundancy checks (CRC-Errors), and frame reject modes (FRMR).

Packet Level Statistics. Packet level statistics are records of the different types and quantities of packets the XL PAD has sent to and received from the local async terminals. See Table 6-2 for definitions of the packet descriptions shown on your screen.

Table 6-2.
Packet Level Statistics Definitions

Packet	*Definition*
Data	Packets containing user data generated from DTEs on either end of the network.
Intr	Interrupt packets sent by either end of the network to prompt an immediate confirmation from the opposite end.
RR	Receiver Ready packets sent and received to maintain packet sequence and acknowledge receipt of previous packets.
RNR	Receiver Not Ready packets sent and received to prevent further packet transmissions.
Reset	Packets sent and received to reset the packet sequencing mechanism to zero.
Call	Call request packets sent and received to establish a virtual circuit.
Clear	Call clearing packets sent and received to disconnect a virtual call.
Restart	Restart packets sent and received to reinitialize all virtual circuits and logical channels.
Invalid	Invalid packets received with incorrect field syntax. (Fields received out of order or with errors.)

View Async Statistics

Select 2 from the GET STATISTICS menu to display the async statistics submenu on you screen as it appears below:

```
VIEW ASYNC STATISTICS (1.3.3)
1> All ports statistics
2> Per port statistics
Enter number (X to exit):
```

All Ports Statistics. Select 1 from the VIEW ASYNC STATISTICS menu to view the statistics for the async ports as a group. As with the X.25 statistics, you will see the values accumulated since the async statistics were last cleared. After your selection, a display similar to the one below appears:

```
ALL PORTS STATISTICS:

        Chars   Pkts   Intpt   Qbit   Reset   Call   Acpt
Snd:    515     306    0       2      0       2      0
Rcv:    40256   716    0       6      0       0      2

        X.29 errs    X.28 errs
Snd:
Rcv:       0            0
```

See Table 6-3 for descriptions of the various items in the All ports statistics display.

Table 6-3.
All Ports Statistics Definitions

Header	*Description*
Chars	ASCII characters the XL PAD has assembled into data packets and forwarded to the network combined with those the PAD has dissassembled from data packets and forwarded to the async ports.
Pkts	Total packets the XL PAD has assembled and forwarded to the network combined with those the PAD has disassembled and forwarded to the async ports.
Intpt	Interrupt packets the XL PAD has transmitted to and received from the network.
Qbit	The number of control packets (X.29 PAD commands) the XL PAD has sent to and received from the network. The Q bit is set to 1 in all control packets.
Reset	Reset packets the XL PAD has transmitted to and received from the network.
Call	Call request packets the XL PAD has transmitted to and received from the network.
Acpt	Call accept packets the XL PAD has transmitted to and received from the network.
X.28 errs	X.28 syntax errors (committed by the user) the XL PAD has received from the async device.
X.29 errs	X.29 protocol errors the XL PAD has reported to the network.

Per Port Statistics. Select 2 from the VIEW ASYNC STATISTICS menu to view the statistics for each individual async port. After you make the menu selection, the XL PAD prompts you to choose a port number. When you select a port, a statistics display similar to the one below appears on your screen.

```
STATISTICS FOR PORT #n, CONTROL SESSION #n
OUTGOING: CLD_ADDR- /CLG_ADDR-

STATISTICS FOR PORT #n, LOGICAL CHANNEL #n
INCOMING: CLD_ADDR- /CLG_ADDR-

        Chars   Pkts   Intpt   Qbit   Reset
Snd:    1000    38     0       0      0
Rcv:    280     10     1       1      0
```

Either CONTROL SESSION #2, OUTGOING, CLD_ADDR:89, CLG_ADDR: or LOGICAL CHANNEL #2, INCOMING, CLD: 02, CLG: 01 appear on screen only when a call is engaged for a port. CONTROL SESSION #2 is a session established on logical channel #2 for a local call to the control terminal port. CLD_ADDR displays the called address field of call request packets. CLG_ADDR displays the calling address field of call request packets. LOGICAL CHANNEL #2 is the logical channel number the port is currently using.

See Table 6-4 for descriptions of the per port statistics items shown above.

Table 6-4.
Per Port Statistics Definitions

Header	*Description*
Chars	ASCII characters the XL PAD has assembled into data packets and forwarded to the network combined with those the PAD has disassembled from data packets and forwarded to the async port you selected.
Pkts	Total data packets the XL PAD has assembled and forwarded to the network combined with those the PAD has disassembled and forwarded to the async port you selected.
Intpt	Interrupt packets the XL PAD has assembled and forwarded to the network combined with those the PAD has disassembled for the async port you selected.
Qbit	The number of control packets (X.29 PAD commands) the XL PAD has sent and received for the async port you selected. The Q bit is set to 1 in all control packets.
Reset	Reset packets the XL PAD has assembled and forwarded to the network combined with those the PAD has disassembled for the async port you selected.
Expanded Menus Only:	
Interrupt	The XL PAD port cannot send any more characters to the background. The background does not have enough time to run because higher-level interrupts are taking all the processor time.
Background	The PAD cannot send any packets to the network from the port software.
Overrun	The number of interrupts that occur on the port that are not processed before the next character comes into the port. This causes the loss of a character.

The per port statistics described on the preceding page are reset to zero when a new call is accepted for the selected port or when you enter the Clear Async Statistics menu selection for a port. If you enter the CLEAR command to halt communications, the statistics in effect when you entered the CLEAR command are frozen until the next call or until you enter the Clear Async Statistics menu selection.

Clear X.25 Statistics

Select 3 from the GET STATISTICS menu to clear all previously recorded X.25 statistics. When you make this selection, all values are reset to zero and displayed as in the example below:

```
X.25 STATISTICS:

FRAME LEVEL STATISTICS
  I-Frames   T1    Aborts    Overruns    Idle-Line
Snd:  0       0
Rcv:  0       0      0          0            0

          REJ    CRC-Errors    FRMR
Snd:                            0
Rcv:       0         0          0

PACKET LEVEL STATISTICS
          Data          Intr         RR          RNR
Snd:        0             0           0            0
Rcv:        0             0           0            0

          Reset    Call    Clear    Restart    Invalid
Snd:        0        0       0         0          0
Rcv:        0        0       0         0          0
```

New values start accumulating immediately after you clear the X.25 statistics, so you may see some nonzero values in the display. Nonzero values represent activity on ports other than the one you are using, or the packet level activity required to display the cleared X.25 statistics on your screen.

Clear Async Statistics

Enter 4 from the GET STATISTICS menu to display the CLEAR ASYNC STATISTICS submenu shown below:

```
CLEAR ASYNC STATISTICS (1.3.6)
1> All ports statistics
2> Per port statistics
Enter number (X to exit)
```

All Ports Statistics. To clear the aggregate async ports statistics, enter 1 from the CLEAR ASYNC STATISTICS menu. When you enter your selection, the XL PAD confirms that the all ports statistics have been reset to zero and displays them as in the following example:

```
ALL PORTS STATISTICS CLEARED

          Chars   Pkts   Intpt   Qbit   Reset   Call   Acpt
Snd:        0       0      0       0      0       0      0
Rcv:        0       0      0       0      0       0      0

          X.29 errs    X.28 errs
Snd:
Rcv:         0             0
```

New values start accumulating immediately after you clear the all ports statistics, so you may see some nonzero values in the display. Nonzero values represent activity on ports other than the one you are using, or the packet level activity required to display the cleared all ports statistics on your screen.

Per Port Statistics. To clear the per port statistics, enter 2 from the CLEAR ASYNC STATISTICS menu. The XL PAD then prompts you to enter the port number where statistics will be cleared. After you enter a port number, the XL PAD confirms that the per port statistics have been reset to zero for the port you selected, and displays them as in the following example:

```
PORT 1 STATISTICS CLEARED

        Chars    Pkts    Intpt    Qbit    Reset
Snd:      0        0       0        0       0
Rcv:      0        0       0        0       0

Input     Interrupt    Background    Overruns
Reject:       0             0            0
Counts
```

New values start accumulating immediately after you clear the per port statistics, so you may see some nonzero values in the display. If you are clearing statistics for the port you used to access the control channel, nonzero values represent the async port activity required to display the cleared per port statistics on your screen. If you are clearing statistics for a port other than the one you used to access the control channel, nonzero values represent continued activity on that port.

Clear All Statistics

Select 5 from the GET STATISTICS menu to clear all X.25 and async statistics. When you enter your selection, the XL PAD displays the following prompt indicating all statistics have been cleared:

```
ALL STATISTICS CLEARED
```

The XL PAD does not display the long list of X.25 and async statistics along with the above prompt, but all values are reset to zero following your entry.

View System Statistics

Enter 6 from the GET STATISTICS menu to display all system statistics. A statistics display similar to the one below appears on your screen:

```
Tokens  Token    Max   CPU  Buffer  BfrRtn   Buffer
  Sent  Fails  Tokens  Factr  Fails  Errors  Emgcys
   475      0      14    3%      0       0        0
```

See Table 6-5 for descriptions of the system statistics items shown above.

Table 6-5.
System Statistics Definitions

Header	*Description*
Tokens Sent	The total number of tokens sent.
Token Fails	The number of tokens that have not been accepted correctly.
Max Tokens	The peak number of tokens in process at one time in the system.
CPU Factor	Reports the percentage of processor load.
Buffer Fails	The number of buffers that are unavailable.
Bfr Rtn Errors	Records the number of buffers that are returned without being assigned.
Buffer Emgcys	The number of free buffers available has reached a critical level.

Clear System Statistics

Select 7 from the GET STATISTICS menu to clear all system statistics. When you make this selection, all values are reset to zero and displayed as in the example below:

```
Tokens  Token    Max   CPU  Buffer  BfrRtn   Buffer
  Sent  Fails  Tokens  Factr  Fails  Errors  Emgcys
     0      0       0    0%      0       0        0
```

New values start accumulating immediately, so you may see some nonzero values in the display.

View Broadcast Statistics

To view broadcast statistics, enter 8 from the GET STATISTICS menu. After you make the menu selection, the XL PAD prompts you to make a broadcast channel selection. When you have selected a broadcast channel, a statistics display similar to the one below appears on your screen:

```
BROADCAST CHANNEL #1 STATISTICS

LONGEST MBIT SEG RCVD: 9 pkts

WHOLE MBIT SEGS DISCARDED:

  PORT1  PORT2  PORT3  PORT4  PORT5  PORT6  PORT7  PORT8
      2      1      1      0      0      3      0      0

ADDITIONAL SINGLE PACKETS DISCARDED:

  PORT1  PORT2  PORT3  PORT4  PORT5  PORT6  PORT7  PORT8
      4      0      3      2      3      0      0      0
```

See Table 6-6 for descriptions of broadcast statistics.

Table 6-6.
Broadcast Statistics Definitions

Header	*Description*
Longest Mbit Sequence Received	Longest mbit sequence that has been received for broadcast channels.
Whole Mbit Sequence Discarded	The number of broadcast mbit sequence messages that have been totally discarded for each port.
Additional Single Packets Discarded	The number of broadcast message single packets that have been discarded for each port.

Clear Broadcast Statistics

Select 9 from the GET STATISTICS menu to clear all broadcast statistics. After you make the menu selection, the XL PAD prompts you to make a broadcast channel selection. When you enter a channel number, the broadcast statistics are reset to zero for the channel you selected. The PAD displays them as in the following example:

```
BROADCAST CHANNEL #1 STATISTICS

LONGEST MBIT SEG RCVD: 0 pkts

WHOLE MBIT SEGS DISCARDED:

    PORT1 PORT2 PORT3 PORT4 PORT5 PORT6 PORT7 PORT8
        0     0     0     0     0     0     0     0

ADDITIONAL SINGLE PACKETS DISCARDED:

    PORT1 PORT2 PORT3 PORT4 PORT5 PORT6 PORT7 PORT8
        0     0     0     0     0     0     0     0
```

DIAGNOSTICS

Select 4 from the PAD CONFIGURATION MAIN MENU to access packet level diagnostic information. The DIAGNOSTICS menu appears as shown below:

```
DIAGNOSTICS (1.4)
1) Packet Level Probe
2) Packet Level Trace
Enter number (X to exit):
```

Packet Level Probe

Select 1 from the DIAGNOSTICS menu to access packets level information for specific logical channel numbers. The PACKET LEVEL PROBE menu appears as shown below:

```
PACKET LEVEL PROBE (1.4.1)
1) Set Probe
2) Reset Probe
3) Display Probe Trace
Enter number (X to exit):
```

Set Probe. Select 1 from the PACKET LEVEL PROBE menu to specify the logical channel numbers to be traced. Every packet that the selected logical channel number(s) receive or transmit is saved for review at a later time.

Reset Probe. Select 2 from the PACKET LEVEL PROBE menu to disable the packet level trace on a previously selected logical channel number.

Display Probe Trace. Select 3 from the PACKET LEVEL PROBE menu to display the packet level trace for logical channels that have been selected for display. A display similar to the one below appears on your screen:

```
020000 Xmt Pkt ( 4) 1001020D0000 Data(0,1), LC=1
```

The above example shows that the time stamp is 020000, the packet direction is transmit, the byte count is 4, and the first 6 bytes in the packet (including the packet header), is 1001020D0000. Also shown is the packet type with a receive sequence number of 0 and a send sequence number of 1, and a logical channel (LC) number of 1.

The time stamp is a count of 1 millisecond clock pulses that calculate the relative time between packets. The byte count is the number of valid bytes in the packet. ■ **Note:** If the byte count is less than six, then only one, two, three, four, or five bytes of displayed packet data are valid.

Packet Level Trace

Select 2 from the DIAGNOSTICS menu to display a trace of all packet level traffic. See Display Probe Trace above for a description of the packet level trace.

X.25 CAUSE CODES AND DIAGNOSTIC CODES

Some X.25 packets contain bit codes that describe the causes for generation of clear indication, reset indication, and restart indication packets. The bit codes for these causes are found in the fourth octet of packets coming into the XL PAD, but are decoded by the PAD and displayed on your screen as hexadecimal equivalents. An example of a clear indication as it might appear on your terminal follows:

```
CLEAR CAUSE: DTE ORIGINATED (0x0000) DIAGNOSTIC: 0x0000
```

The clear indication display that appears above also contains the hexadecimal equivalents that describe the diagnostic fields of incoming clear indication, reset indication, and restart indication packets. The bit codes for these causes are found in the fifth octet of packets coming into the XL PAD, but are decoded by the PAD and displayed on your screen as hexadecimal equivalents.

Use the tables at the end of Chapter 7 to decode the hex characters that appear in the last two positions of the cause code and diagnostic code in the packet types described above.

Chapter 7
Reference

Contents

Configuration Worksheets 7-1
  Address Records 7-1
  X.25 Parameters 7-4
  Per Port Parameters 7-6
  X.3 Profiles 7-9
  All Ports Parameters 7-10
  Broadcast Parameters 7-10
X.3 Parameter Guide 7-11
XL PAD Command List 7-16
Cause Codes for Clear Indication, Reset Indication, and Restart Indication Packets 7-18
Diagnostic Codes for Clear, Reset, and Restart Indication, Registration Confirmation, and Diagnostic Packets 7-19
Decimal/Hexadecimal/ASCII Conversion Chart 7-22

CONFIGURATION WORKSHEETS

The worksheets in the following section will help you to keep track of the many settings required for the XL PAD per port, X.3, and X.25 parameters. They also provide a place to record the various types of addresses for each port and channel.

Address Records

Use these worksheets to record addresses for ports, channels, and the entire XL PAD. Mnemonic addresses and auto call parameters/addresses are also included. You can also make extra copies of these worksheets to record address information for remote XL PADs in your network.

Address Records

	ASYNC PORT OR DTE ADDRESS (CALLING ADDRESS)	DEFAULT LISTEN PATTERN	DEFAULT LISTEN TYPE	NETWORK (LISTEN) ADDRESS	USER DATA PATTERN	USER DATA MASK
XL PAD						
PORT 1						
PORT 2						
PORT 3						
PORT 4						
PORT 5						
PORT 6						
PORT 7						
PORT 8						
CTRL CHAN						
BCST CHAN 1						
BCST CHAN 2						
BCST CHAN 3						
BCST CHAN 4						
BCST CHAN 5						
BCST CHAN 6						
BCST CHAN 7						
BCST CHAN 8						
	1–15 Decimals/ Wild-Cards	1–15 Decimals for Listen Type Address, 1–12 ASCII for Listen Type Data	ADDR or Data	1–15 Decimals/ Wild-Cards	1–16 Hex or ASCII	1–16 Hex Chars 00 or FF

Mnemonic Address Records

MNEMONIC ADDRESS NUMBER	MNEMONIC ADDRESS NAME
1–15 Decimals	1–10 Alphanumeric

Auto Call Parameters

	AUTO CALL ADDRESS	AUTO CALL DELAY INTERVAL	AUTO CALL FACILITIES	AUTO CALL USER DATA
XL PAD				
PORT 1				
PORT 2				
PORT 3				
PORT 4				
PORT 5				
PORT 6				
PORT 7				
PORT 8				
CTRL CHAN				
BCST CHAN 1				
BCST CHAN 2				
BCST CHAN 3				
BCST CHAN 4				
BCST CHAN 5				
BCST CHAN 6				
BCST CHAN 7				
BCST CHAN 8				
	1—15 Decimals	0–65, 535 Seconds	Up to 63 Hex Characters	1-12 ASCII

X.25 Parameters

Use this worksheet to record values you have set for the X.25 parameters for either local or remote XL PADs. For further information about X.25 network parameters, consult Chapter 3.

X.25 (Network Port) Parameters			
X.25 Parameter	*Valid Entries*	*Default*	*User Setting*
PAD Calling Address	(Any 15 numerals)	0	
Calling Address Insertion	ENaBle or DISable	DIS	
Default Packet Size	128, 256, 512	128	
*Lowest SVC Number	0 to 4095	1	
*Highest SVC Number	0 to 4095	11	
*DTE/DCE	DTE or DCE	DTE	
Expanded Menus			
*Frame Level Window Size	1 to 7	7	
*T1 Timer	1 to 53	3	
*N2 Timeouts	1 to 255	20	
*Maximum Packet Size	128, 256, 512	512	
Default Packet Window Size	1 to 7	2	
Clear Request Has Diagnostic	DIAG or NODIAG	DIAG	
Reset Request Has Diagnostic	DIAG or NODIAG	DIAG	
Restart Request Has Diagnostic	DIAG or NODIAG	DIAG	
Packet Level Options	NPWS, NOCNFOK, NORSTRT, ALL, NONE	NOCNFOK	
*Frame Level Options	DISC, SABM, ALL, NONE	DISC + SABM	
Restart Timer	0 to 255	18	
Restart Retries	0 to 255	255	
Call Request Timer	0 to 255	6	
Reset Request Timer	0 to 255	18	
Reset Retries	0 to 255	1	
Clear Request Timer	0 to 255	18	
Clear Request Retries	0 to 255	1	
Minimum Negotiated Packet Size	PS_64, PS_128, PS_256, PS_512	PS_128	

■**Note:** The asterisk preceding some of the above parameters indicates that the parameter is not enabled until the next PAD reboot, system reboot, or power cycle.

Per Port Parameters

Use this worksheet to record the per port parameters you have set for each port. Port numbers are represented in the following worksheet by the symbol *n*, so you may have to reproduce the worksheet up to eight times to record the per port parameter settings for all ports. Also included are the async device modes for each async port. See Chapter 3 for a detailed explanation of per port parameters and async device modes.

Per Port Parameters for Port n			
Per Port Parameter	*Valid Entries*	*Default*	*User Setting*
Async Port Calling Address	1–15 decimals/wild cards	*0*n*	
Default Listen Type	ADDR, DATA, NONE	ADDR	
Default Listen Pattern	1–15 decimals with ADDR, 1–12 ASCII characters with DATA	0*n*	
Enable Auto Baud	ENB, DIS	ENB	
Default Speed	B50, B75, B100, B110, B134__5, B150, B200, B300, B600, B1200, B1800, B2400, B4800, B9600, B19200	B9600	
Enable Auto Parity	ENB, DIS	DIS	
Parity Type	NO__8, EVEN__7, ODD__7, NO__7	NO__8	
Highest X.3 Parameter Read by REMOTE DTE	UPTO__80, UPTO__84	UPTO__84	
Expanded Menus			
Stop Bits	0 (2 bits/char at or below 110 baud, 1 bit/char above 110 baud), 1 (1 bit/char), 2 (2 bits/char), 3 (1.5 bits/char)	0	
I/O Mode	NO EOL, NONE	NONE	
X.28 Per Port Options	RCMDS, NONE	NONE	
Maximum Output Buffers to Queue at Async Interface	1 to 10	4	
XON Hysteresis	0 to 50	4	
Data Restraint Output Signal	DTR, RTS, NONE	RTS	
Type of Data Restraint Output	XONXOFF, SIGNAL, ALL, NONE	XONXOFF	
Data Restraint Input Signal	DSR, DCD, CTS, NONE	CTS	
Type of Data Restraint Input	XONXOFF, SIGNAL, ALL, NONE	XONXOFF	
Bell Character	0 to 255	7	

Per Port Parameters for Port n (continued)			
Per Port Parameter	*Valid Entries*	*Default*	*User Setting*
XOFF Character	0 to 255 (Except for 13 and 43)	19	
XON Character	0 to 255 (Except for 13 and 43)	17	
Asserted Connection Signal	DSR, DCD, CTS, ALL, NONE	DSR + DCD + CTS	
Sensed Connection Signal	DTR, RTS, ALL, NONE	DTR + RTS	
Asserted Invitation to Connect Signal	DSR, DCD, CTS, ALL, NONE	NONE	
Sensed Invitation to Connect Signal	DTR, RTS, ALL, NONE	NONE	
All Incoming Signals Must be Active	CONALL, ITCALL, ALL, NONE	NONE	
Disconnect Wait Timer Interval	0 to 65, 535	0	
Connection Timer Interval	0 to 65, 535	0	
Asserted Connection Signal Options	CTRL, NONE	NONE	
When to Raise Asserted Connection Signal to Initiate Connection	DITC, ICALL, ACTV, ALL, NONE	NONE	
When to Drop Asserted Connection Signal to Initiate Disconnection	RCLR, ICLR, UCLR, EXPVCE, ALL, NONE	NONE	
When to Respond to the Sensed Connection Signal	UPWT, DNWT, UPRSP, DNRSP, ALL, NONE	UPWT + DNRSP	
When to Pulse the Asserted Invitation to Connect Signal	X.25UP, ICALL, ACTV, ALL, NONE	NONE	
Sensed Handshake Signal	DTR, RTS, ALL, NONE	NONE	
Asserted Handshake Signal	DSR, DCD, CTS, ALL, NONE	NONE	

X.3 Profiles

Port #	Profile	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	X1	X2	X3	X4
1																											
2																											
3																											
4																											
5																											
6																											
7																											
8																											

User Profiles

Profile	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	X1	X2	X3	X4

Permanent Profiles

Profile	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	X1	X2	X3	X4
DEFAULT	64	1	2	0	2	5	2	0	25	72	0	1	5	25	1	8	24	18	1	0	0	0	8	0	1	0
SCEN	64	1	2	0	1	5	21	0	0	0	0	1	4	0	1	127	24	18	1	0	0	0	8	0	1	0
CC__SSP	1	1	126	0	1	1	2	0	0	0	0	1	0	0	0	127	24	18	1	0	0	0	8	0	1	0
CC__TSP	0	0	0	20	0	0	2	0	0	0	0	0	0	0	0	127	24	18	1	0	0	0	0	0	0	0
CRT	64	1	2	0	0	5	2	0	0	0	0	1	4	0	1	8	24	18	2	0	3	0	8	0	0	0
HARDCOPY	64	1	2	0	2	5	21	0	5	80	0	1	4	5	1	8	24	18	1	0	3	0	8	0	1	0
HDX	1	1	2	0	2	5	2	0	0	0	0	1	4	0	1	8	24	18	2	0	3	0	8	0	1	1
SHARK	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

X.3 Profiles

Use this worksheet to record X.3 default or user profiles you have enabled for an async port. You can also use the worksheet to record individual X.3 parameters and the four extra XL PAD parameters. For further information on X.3 and extra XL PAD parameters, consult the "X.3 Parameter Guide" that follows in this chapter.

All Ports Parameters			
All Ports Parameter	*Valid Entries*	*Default*	*User Setting*
Incoming Call Wait Timer Interval	0 to 65, 535 Seconds	120	
Virtual Call Establishment Timer Interval	0 to 65, 535 Seconds	600	
Speed Sense Timer Interval	1 to 20 Seconds	3	

Broadcast Parameters			
Broadcast Parameter	*Valid Entries*	*Default*	*User Setting*
Maximum Packets per Port	1 to 80 Packets	10	
Longest Mbit Sequence	< = to Maximum Packets per Port Above	5	

All Ports Parameters

Use this worksheet to record the all ports parameters you have set for each port. For more information on all ports parameters, see Chapter 3.

Broadcast Parameters

Use the worksheet to record the values you have set for the broadcast parameters. Consult Chapter 3 for more information on broadcast parameters.

X.3 PARAMETER GUIDE

The X.3 recommendation specifies a set of parameters that determine how the XL PAD processes data it receives from and sends to its attached async devices. The 1984 version of X.3 lists a set of 22 parameters that dictate PAD functions in relation to each async device or port. In addition to the 22 parameters specified by the 1984 version of X.3, the XL PAD also has 4 extra parameters. These extra parameters have been added to enable the XL PAD to accommodate different brands of async devices. This guide lists each of the X.3 and extra XL PAD parameters and describes the available settings for each.

Throughout the following guide, the X.3 parameter reference number used in the command mode appears first in each header. Each parameter number is followed by an italicized parameter description taken from the control channel prompts. The parameter settings shown under each heading follow the same format; the setting number used in the command mode is followed by the setting description (in italics) used for the control channel. When the settings are the same for both the control channel and the command mode, or when a setting is only available for the control channel or command mode but not both, only one setting is listed.

1 Pad Recall

Your selection determines which ASCII character is entered to escape from the data transfer mode to X.28 and X.29 Command modes.

0 = User cannot enter command mode.
1 = DLE
64 = @
32-126 = ASCII character specified by decimal number.

2 Echo

This parameter determines whether characters will be echoed back to the local async device as they are entered.

0/*DIS* = PAD does not echo characters back to async device.
1/*ENB* = PAD echoes characters back to async device.

3 Data Forwarding*

Your selection defines which ASCII character will be used to signal the PAD to enclose the preceding characters in a packet and forward the packet over the network.

1/*ALPHA* = Any alphanumeric character (A-Z, 0-9).
2/*CR* = CR
4/*EBEA* = ESC, BEL, ENQ, ACK
8/*DCD2* = DEL, CAN, DC2
16/*ENDS* = ETX, EOT
32/*TFS* = HT, LF, VT, FF
126/*CTRL* = All other ASCII control characters.
128/*OTHERS* = All ASCII characters not listed in the preceding settings.
255/ALL = All ASCII characters.
0/*NONE* = No data forwarding character. (Note that forwarding may occur as a result of other events—for example, if the maximum packet size is reached.)

■ **Note:** The X.3 recommendation does not allow a DTE to forward data on every character because it excludes the punctuation characters from the available range of characters for each setting. The XL PAD deviates from the X.3 recommendation for settings 128 and 255 because the XL PAD includes punctuation characters in these settings.

---

*The control channel settings for this parameter can be combined by inserting the + character between different selections. As an example, a setting of ALPHA + ENDS for parameter 3 would tell the XL PAD to forward data on the receipt of alphanumeric characters *and* control characters ETX and EOT. You can combine the standard parameter settings in the same way by adding the desired settings and entering the total. Using the previous example, 1 (ALPHA) plus 16 (ENDS) would total 17 (ALPHA + ENDS).

4 Idle Timer Delay

Your selection will determine how long (in twentieths of a second) the PAD will wait for another character from the async device until the PAD forwards those it has already received to the network.

0 = Disable the timer.
1-255 = Choose a setting from 1 to 255 to indicate .05 to 12.75 seconds.

5 Flow Control of Device

This parameter permits the XL PAD to control the flow of characters from the async device. (The method the XL PAD uses to control the flow of data is determined by the selection ''Type of data restraint input'' accessed through the async port parameter menu of the control channel.)

0/*NONE* = PAD cannot impose flow control on the async device.
1/*DATA* = PAD will control the async device data flow in the data transfer mode only.
2/*ALL* = PAD will control the async device data flow in the data transfer and command modes.

6 Service Signals*

The PAD service signals indicate the operating status of the PAD to the local async device. The service signals are sent from the PAD to the async device in response to command signals sent from the async device to the PAD. Select from the following:

1/*OTHERS* = Transmit service signals other than the prompt PAD signal (*) to the async device.
4/*PROMPT* = Transmit only the prompt PAD signal to the async device.
5/*OTHERS+PROMPT* = Transmit the service and prompt PAD signals to the async device.
0/*NONE* = Terminal cannot receive service signals.

7 Action on Break*

Enter one of the following to determine what the PAD should do when it receives a break signal from the async device:

1/*INTPT* = PAD will send an interrupt packet to the network.
2/*RESET* = PAD will send a reset packet to the network.
4/*INDBRK* = PAD will send an indication of break signal to the network.
8/*ESC* = PAD will escape from the data transfer mode.
16/*DISC* = PAD will discard data coming in from the network to the async device.
31/*ALL* = ENABLE ALL THE ABOVE OPTIONS
0/*NONE* = PAD will not respond to a break signal.

■ **Note:** The XL PAD deviates from the X.3 recommendation because the PAD allows any of the above settings or combinations of the above settings, while X.3 specifies only settings 0, 1, 2, 5, 8, and 21, or combinations thereof.

8 Discard Output

Use this parameter to tell the PAD whether or not to discard data coming in from the network to a local async device. This parameter is normally left at a setting of 0. If you select a value of 16/DISC for parameter reference number 7, the PAD then automatically changes the Discard Output setting to 1 when the PAD receives a break signal from the local async device.

0 = Do not discard incoming data from the network.
1 = Discard incoming data from the network.

---

*The control channel settings for this parameter can be combined by inserting the + character between different selections. As an example, a setting of ALPHA+ENDS for parameter 3 would tell the XL PAD to forward data on the receipt of alphanumeric characters *and* control characters ETX and EOT. You can combine the standard parameter settings in the same way by adding the desired settings and entering the total. Using the previous example, 1 (ALPHA) plus 16 (ENDS) would total 17 (ALPHA+ENDS).

9 Padding after Carriage Return

Use this parameter to determine how many padding characters the PAD will send to an async device after each carriage return character.

0 = No padding characters after CR.
1-255 = Choose the number of padding characters from 1-255.

10 Line Folding

Select the number of characters the PAD will send to the async device before inserting CR to fold the line (LF will also be inserted if parameter 13 is set to 4). This setting will be determined by the number of characters per line the DTE will accommodate.

0 = The PAD will not perform line folding.
1-255 = The number of characters the PAD will send before inserting CR (and LF if parameter 13 is set to 4).

11 Speed

The binary speed of each port is a read only parameter. The setting is actually controlled by the default speed and auto baud selections in the PER PORT PARAMETERS menu. If you are configuring profiles in the control channel, skip to the next parameter without making an entry for parameter 11. If you are using the command mode, do not attempt to change the default setting of zero.

0/*READ ONLY* = No entry required. Setting cannot be changed.

12 Flow Control of PAD

This parameter permits the local async device to control the flow of data coming to the async device from the XL PAD. (The method the async device uses to control the flow of data is determined by the selection ''Type of data restraint output'' accessed through the ASYNC PORT PARAMETERS menu of the control channel.)

0/*DISABLE* = No flow control of the PAD by the async device.
1/*ENABLE* = Terminal can control the flow of data from the PAD to the async device.

13 Linefeed Insertion*

Use this parameter to determine when the PAD will insert line feed characters following carriage return characters. ■ **Note:** As an added feature, the XL PAD applies the Linefeed Insertion parameter setting in both the data transfer and command modes, rather than solely the data transfer mode as specified by the CCITT.

1/*OUTP* = PAD will insert LF after each CR character it receives from the network prior to forwarding it to the async device.
2/*INPUT* = PAD will insert a LF character after every CR character it receives from the async device.
4/*ECHO* = PAD will insert a LF character after every CR character it echoes to the async device.
7/*ALL* = ENABLE ALL THE ABOVE OPTIONS
0/*NONE* = PAD will not insert LF.

14 LF Padding

Select the number of padding (NUL) characters the PAD should insert following each LF character.

0 = No padding characters after LF.
1-255 = Choose the number of padding characters to appear after LF. The valid range is from 1-255.

15 Editing

Use this parameter to allow or disallow the PAD to provide editing signals to the async device during the data transfer mode.

0/*DIS* = The PAD is only allowed to send editing signals in the command mode.
1/*ENB* = The PAD will send editing signals in the data transfer and command modes.

---

*The control channel settings for this parameter can be combined by inserting the + character between different selections. As an example, a setting of ALPHA+ENDS for parameter 3 would tell the XL PAD to forward data on the receipt of alphanumeric characters *and* control characters ETX and EOT. You can combine the standard parameter settings in the same way by adding the desired settings and entering the total. Using the previous example, 1 (ALPHA) plus 16 (ENDS) would total 17 (ALPHA+ENDS).

16 Character Delete Character

Select the ASCII character that the async device will use as a character delete signal to the PAD.

8 = The backspace character (BS).

127 = The delete character (DEL).

0-127 = Any remaining ASCII character represented by decimal numbers 0-127.

17 Line Delete Character

Enter the ASCII character that will signal the PAD to delete the last line the PAD received from the async device.

24 = The cancel (CAN) character.

0-127 = Any remaining ASCII character represented by decimal numbers 0-127.

18 Line Display Character

Enter the ASCII character that will signal the PAD to transmit the last line the PAD received to the async device.

18 = The ASCII character (DC2).

0-127 = Any remaining ASCII character represented by decimal numbers 0-127.

19 Editing PAD Service Signals

Your selection will determine how the PAD responds to the async device when the PAD receives one of the characters specified in parameters 16 or 17.

0 = PAD will not send service signals to the async device when editing characters are received.

1 = Editing for printing devices. The PAD will send a backslash character (\) in response to a character delete character and the sequence XXX CR LF in response to a line delete character.

2 = Editing for CRT terminals. The PAD will send the sequence BS SP BS in response to a character delete character. The PAD will send the aforementioned sequence in series for each character in a line to be deleted when the PAD receives a line delete character.

8 = The PAD will send a backspace character in response to a character delete character and a series of backspace characters in response to a line delete character.

32-126 = The PAD will send the ASCII character specified by the decimal number you enter in response to a character delete character. See (1) for the PAD response to a line delete character.

20 Echo Mask*

When you have enabled parameter 2 (echo), parameter 20 is used to prevent the PAD from echoing certain characters back to the async device. The XL PAD function differs slightly from the CCITT recommendation: editing characters are always masked, regardless of your setting. Select from the following:

1/*CR* = Mask CR.
1 2/*LF* = Mask LF@.
4/*VTHTFF* = Mask VT, HT, and FF characters.
8/*BELBS* = Mask BEL and BS characters.
16/*ESCENQ* = Mask ESC and ENQ characters.
32/*BSC* = Mask ACK, NAK, STX, SOH, EOT, ETB, and ETX characters.
64 = All editing characters will be masked. (This selection is permanently enabled so that you do not need to select it.)
128/*OTHERS* = Mask balance of ASCII characters not mentioned above.
255/*ALL* = ENABLE ALL THE ABOVE OPTIONS
0/*NONE* = All characters will be echoed.

21 Parity Treatment

This parameter enables the PAD to check for parity in characters the PAD receives from the async device, and to generate parity in the packets it sends to the async device. Select one of the following codes:

0/*IGNORE* = PAD will not check for or generate parity.
2/*GEN* = PAD will only generate parity.
3/*CHKGEN* = PAD will check for and generate parity.

22 Page Wait

You can use this parameter to specify how many lines the PAD will send to an async device before the PAD must stop to wait for a response. The number you enter will generally be the number of lines your async device can print on one page or screen.

0 = PAD will not stop to wait for a response.
1-255 = Number of lines the PAD will send to an async device before the PAD stops to wait for a response.

■ **Note:** The XL PAD implementation of Page Wait is non-standard. Any character sent from the local async device will cancel the page wait condition and reset the linefeed count. To cancel Page Wait at any time without transmitting further data, key in the XON character. To continue your input of data without scrolling a frozen page, key in XOFF and continue data entry.

Extra Parameter 1 Local Tab Expansion

When extra parameter 3 is enabled, you can use extra parameter 1 to specify the number of spaces between tab stops for the local async device. When extra parameter 3 is disabled, the PAD uses this parameter to track the position of the cursor on the local async device after a tab character is entered. The local async device's tab stops must match the number of tab stops you select with this parameter in order to perform line folding, character deletion, and line deletion correctly.

0 = No tab expansion.
1-16 = The number of spaces between tab stops on the local async device.

---

*The control channel settings for this parameter can be combined by inserting the + character between different selections. As an example, a setting of ALPHA + ENDS for parameter 3 would tell the XL PAD to forward data on the receipt of alphanumeric characters *and* control characters ETX and EOT. You can combine the standard parameter settings in the same way by adding the desired settings and entering the total. Using the previous example, 1 (ALPHA) plus 16 (ENDS) would total 17 (ALPHA + ENDS).

Extra Parameter 2 Remote Tab Expansion

Enter the number of spaces between tab stops on the remote DTE. The XL PAD will substitute the appropriate number of spaces to position the cursor at the next tab stop on the remote DTE.

0 = No tab expansion.
1-16 = The number of spaces between tab stops on the remote DTE.

Extra Parameter 3 Enable Local Tab Expansion

Select ENB to enable the PAD to substitute spaces for tab characters in data the PAD is transmitting to the local async device. Select DIS to prevent the PAD from substituting spaces for tab characters in data the PAD is sending to the local async device.

*/*ENB* = Enable local tab expansion.
*/*DIS* = Disable local tab expansion.

Extra Parameter 4 Half-Duplex Mode

You can use this parameter to select full- or half-duplex operation for the selected port.

*/*ENB* = Enable half-duplex operation for the selected port.
*/*DIS* = Disable half-duplex operation for the selected port; enable full-duplex operation.

XL PAD COMMAND LIST

The Command list in Table 7-1 is a summary of the XL PAD commands fully described in Chapter 5. Following some of the commands, additional suffixes and command syntax are also listed. This list is intended as a quick reference only, and does not describe how to use the commands.

Table 7-1.
XL PAD Command List

Command	*Description*
CALL *address* [*P](password) [*D](user data)	Place a virtual call
CALL ?	Displays the address previously called
CLR	Clear a virtual circuit
FACILITIES	Set the facilities field in a call request packet
FACILITIES *	Set the facilities field in a call request packet to default values
FULL	Enable full-duplex transmission
HALF	Enable half-duplex transmission
HALF *	Enable half-duplex transmission without echoing any characters
HALF (character 1,character n)	Enable half-duplex transmission and echo the listed ASCII characters
HALF (-character 1,-character n)	Enable half-duplex transmission, but do *not* echo the listed ASCII characters
HELP	Display XL PAD commands
INTERRUPT	Send an interrupt request packet
LISTEN ADDR (address)	Set a listen pattern to match the address field of incoming call request packets
LISTEN DATA (user data)	Set a listen pattern to match the data field of incoming call request packets
PAR? (reference #1, reference #n)	Display specified X.3 parameters and values
PAR?	Display all X.3 parameters and values
PROF	Display profile name currently enabled or set a profile when command is followed by profile name
PROF ?	Display profile name currently enabled and a list of available profiles
RESET	Send a reset request packet
SET (reference #1:value, reference #n:value)	Set specified X.3 parameters
SET? (reference #1:value, reference #n:value)	Set selected X.3 parameters and then display new settings
STATUS	Display virtual circuit status
TABS [LCL] (value) [REM] (value) [EXP] (value)	Expand tab characters — see Chapter 5 for command combinations
RPAR?	Display specified X.3 parameter(s) and value(s) of remote
RPROF	Turns X.3 profile settings into Set and Read remote PAD command
RSET	Set specified X.3 parameters on remote
RSET?	Set specified X.3 parameters on remote and then display new setting(s) for remote
RICLR	Send an Invitation to Clear PAD command to remote

■ **Note:** The syntax for remote commands is the same as that for equivalent local commands.

Table 7-2.
Coding for Clearing Cause Field in Clear Indication Packet

Clearing Cause	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*Hex*	*Decimal*
DTE originated	0	0	0	0	0	0	0	0	00	0
DTE originated*	1	x	x	x	x	x	x	0	xx	x
Number busy	0	0	0	0	0	0	0	1	01	1
Out of order	0	0	0	0	1	0	0	1	09	9
Remote procedure error	0	0	0	1	0	0	0	1	11	17
Reverse charge acceptance not subscribed	0	0	0	1	1	0	0	1	19	25
Incompatible destination	0	0	1	0	0	0	0	1	21	33
Fast Select not subscribed	0	0	1	0	1	0	0	1	29	41
Invalid facility request	0	0	0	0	0	0	1	1	03	3
Access barred	0	0	0	0	1	0	1	1	0B	11
Local procedure error	0	0	0	1	0	0	1	1	13	19
Network congestion	0	0	0	0	0	1	0	1	05	5
Not obtainable	0	0	0	0	1	1	0	1	0D	13
RPOA out of order	0	0	0	1	0	1	0	1	15	21

*When bit 8 is set to 1, the bits represented by x are those included by the remote DTE in the Clearing or Restarting Cause field of the Clear or Restart Request packets, respectively.

CAUSE CODES FOR CLEAR INDICATION, RESET INDICATION, AND RESTART INDICATION PACKETS

The following tables contain bit, hexadecimal, and decimal codes that describe the causes for network generation of Clear Indication, Reset Indication, and Restart Indication packets. The bit codes for these causes are found in the fourth octet of packets coming into the XL PAD, but are decoded by the PAD and displayed on your screen as hexadecimal equivalents. An example of a Clear Indication as it might appear on your terminal follows:

```
CLEAR CAUSE: DTE ORIGINATED (0x0000) DIAGNOSTIC:
0x0000
```

In this example, the cause for the clear indication is briefly described and its corresponding hex code is also given—the underscoring in the above example represents the hex code for DTE ORIGINATED.

Use Tables 7-2 through 7-4 to decode the hex character that appears in the last two positions of the cause code.

Table 7-3.
Coding for Resetting Cause Field in Reset Packet

Resetting Cause	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*Hex*	*Decimal*
DTE originated	0	0	0	0	0	0	0	0	00	0
DTE originated*	1	x	x	x	x	x	x	x	xx	x
Out of order (PVC)	0	0	0	0	0	0	0	1	01	1
Remote procedure error	0	0	0	0	0	0	1	1	03	3
Local procedure error	0	0	0	0	0	1	0	1	05	5
Network congestion	0	0	0	0	0	1	1	1	07	7
Remote DTE operational (PVC)	0	0	0	0	1	0	0	1	09	9
Network operational (PVC)	0	0	0	0	1	1	1	1	0F	15
Incompatible destination	0	0	0	1	0	0	0	1	11	17
Network out of order (PVC)	0	0	0	1	1	1	0	1	1D	29

*When bit 8 is set to 1, the bits represented by x are those included by the remote DTE in the Resetting Cause field (SVC and PVC) or the Restarting Cause Field (PVC only) of the Reset or Restart Request packets, respectively.

Table 7-4.
Coding for Resetting Cause Field in Restart Packet

Restarting Cause	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*Hex*	*Decimal*
Local procedure error	0	0	0	0	0	0	0	1	01	1
Network congestion	0	0	0	0	0	0	1	1	03	3
Network operational	0	0	0	0	0	1	1	1	07	7
Registration/cancellation confirmed	0	1	1	1	1	1	1	1	7F	127

DIAGNOSTIC CODES FOR CLEAR, RESET, AND RESTART INDICATION, REGISTRATION CONFIRMATION, AND DIAGNOSTIC PACKETS

Table 7-5 contains bit settings and the hexadecimal and decimal equivalents that describe the diagnostic fields of incoming Clear Indication, Reset Indication, Restart Indication, Registration Confirmation, and Diagnostic packets. The bit codes for these causes are found in the fifth octet of packets coming into the XL PAD, but are decoded by the PAD and displayed on your screen as hexadecimal equivalents. An example of a Clear Indication as it might appear on your terminal follows:

```
CLEAR CAUSE: DTE ORIGINATED (0x0000) DIAGNOSTIC:
0x0000
```

In this example, the underscored hex character is the diagnostic code for "No Additional Information." Use Table 7-5 to decode the hex character that appears in the last two positions of the diagnostic code.

Table 7-5.
Diagnostic Codes in Clear, Reset, and Restart Indication, Registration Confirmation, and Diagnostic Packets

Diagnostic	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*Hex*	*Decimal*
No Additional Information	0	0	0	0	0	0	0	0	00	0
Invalid P(S)	0	0	0	0	0	0	0	1	01	1
Invalid P(R)	0	0	0	0	0	0	1	0	02	2
Packet Type Invalid	0	0	0	1	0	0	0	0	10	16
Other types*	0	0	0	1	x	x	x	x	1x	—
Packet Not Allowed	0	0	1	0	0	0	0	0	20	32
Unidentifiable packet	0	0	1	0	0	0	0	1	21	33
Call on one way logical channel	0	0	1	0	0	0	1	0	22	34
Invalid packet type on a PVC	0	0	1	0	0	0	1	1	23	35
Packet on an unassigned logical channel	0	0	1	0	0	1	0	0	24	36
Reject not subscribed to	0	0	1	0	0	1	0	1	25	37
Packet too short	0	0	1	0	0	1	1	0	26	38
Packet too long	0	0	1	0	0	1	1	1	27	39
Invalid GFI	0	0	1	0	1	0	0	0	28	40
Restart or registration with nonzero in bits 0-3, 8-15	0	0	1	0	1	0	0	1	29	41
Packet type not compatible with facility	0	0	1	0	1	0	1	0	2A	42
Unauthorized interrupt confirmation	0	0	1	0	1	0	1	1	2B	43
Unauthorized interrupt	0	0	1	0	1	1	0	0	2C	44
Unauthorized reject	0	0	1	0	1	1	0	1	2D	45
Timer Expired	0	0	1	1	0	0	0	0	30	48
For incoming call	0	0	1	1	0	0	0	1	31	49
For clear indication	0	0	1	1	0	0	1	0	32	50
For reset indication	0	0	1	1	0	0	1	1	33	51
For restart indication	0	0	1	1	0	1	0	0	34	52

*Refer to CCITT Recommendation X.25 for further details.

(continued on next page)

***Table 7-5 (continued).
Diagnostic Codes in Clear, Reset, and Restart Indication, Registration Confirmation, and Diagnostic Packets***

Diagnostic	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*Hex*	*Decimal*
Call Set-Up, Clearing, or Registration Problem	0	1	0	0	0	0	0	0	40	64
Facility/registration code not allowed	0	1	0	0	0	0	0	1	41	65
Facility parameter not allowed	0	1	0	0	0	0	1	0	42	66
Invalid called address	0	1	0	0	0	0	1	1	43	67
Invalid calling address	0	1	0	0	0	1	0	0	44	68
Invalid facility/registration length	0	1	0	0	0	1	0	1	45	69
Incoming call barred	0	1	0	0	0	1	1	0	46	70
No logical channel available	0	1	0	0	0	1	1	1	47	71
Call Collision	0	1	0	0	1	0	0	0	48	72
Duplicate facility requested	0	1	0	0	1	0	0	1	49	73
Nonzero address length	0	1	0	0	1	0	1	0	4A	74
Nonzero facility length	0	1	0	0	1	0	1	1	4B	75
Facility not provided when expected	0	1	0	0	1	1	0	0	4C	76
Invalid CCITT-specified DTE facility	0	1	0	0	1	1	0	1	4D	77
Miscellaneous	0	1	0	1	0	0	0	0	50	80
Inproper cause code from DTE	0	1	0	1	0	0	0	1	51	81
Not aligned octet	0	1	0	1	0	0	1	0	52	82
Inconsistent Q-bit setting	0	1	0	1	0	0	1	1	53	83
International problem	0	1	1	1	0	0	0	0	70	112
Remote network problem	0	1	1	1	0	0	0	1	71	113
International protocol problem	0	1	1	1	0	0	1	0	72	114
International link out of order	0	1	1	1	0	0	1	1	73	115
International link busy	0	1	1	1	0	1	0	0	74	116
Transit network facility problem	0	1	1	1	0	1	0	1	75	117
Remote network facility problem	0	1	1	1	0	1	1	0	76	118
International routing problem	0	1	1	1	0	1	1	1	77	119
Temporary routing problem	0	1	1	1	1	0	0	0	78	120
Unknown called DNIC	0	1	1	1	1	0	0	1	79	121
Maintenance action	0	1	1	1	1	0	1	0	7A	122
Reserved for Public Network Specific Information	1	0	0	0	0	0	0	0	80	128
Other Types**	1	0	0	0	x	x	x	x	8x	—

**Refer to network supplier documentation for further details.

DECIMAL/HEXADECIMAL/ASCII CONVERSION CHART

Decimal/Hexadecimal/ASCII Conversion Chart

Decimal	*Hex*	*ASCII*
0	00	∧ @ NUL (Null)
1	01	∧ A SOH (Start of Heading)
2	02	∧ B STX (Start Text)
3	03	∧ C ETX (End Text)
4	04	∧ D EOT (End of Transmission)
5	05	∧ E ENQ (Enquiry)
6	06	∧ F ACK (Acknowledge)
7	07	∧ G BEL (Bell)
8	08	∧ H BS (Backspace)
9	09	∧ I HT (Horizontal Tab)
10	0A	∧ J LF (Linefeed)
11	0B	∧ K VT (Vertical Tab)
12	0C	∧ L FF (Formfeed)
13	0D	∧ M CR (Carriage Return)
14	0E	∧ N SO (Shift Out)
15	0F	∧ O SI (Shift In)
16	10	∧ P DLE (Data Link Escape)
17	11	∧ Q DC1 (XON)
18	12	∧ R DC2
19	13	∧ S DC3 (XOFF)
20	14	∧ T DC4
21	15	∧ U NAK (Negative Acknowledge)
22	16	∧ V SYN (Synchronous Idle)
23	17	∧ W ETB (End Transmission Blocks)
24	18	∧ X CAN (Cancel)
25	19	∧ Y EM (End of Medium)
26	1A	∧ Z SUB (Substitute)
27	1B	∧ [ESC (Escape)
28	1C	∧ \ FS (File Separator)
29	1D	∧] GS (Group Separator)
30	1E	∧∧ RS (Record Separator)
31	1F	∧ _ US (Unit Separator)
32	20	SP (Space)
33	21	!
34	22	''
35	23	#
36	24	$
37	25	%
38	26	&
39	27	'
40	28	(
41	29	)
42	2A	*
43	2B	+
44	2C	,
45	2D	-
46	2E	.
47	2F	/
48	30	0
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
58	3A	:
59	3B	;
60	3C	<
61	3D	=
62	3E	>
63	3F	?
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
70	46	F
71	47	G
72	48	H
73	49	I

■ **Note:** ∧ indicates the control key.

(continued on next page)

Decimal/Hexadecimal/ASCII Conversion Chart (continued)

Decimal	*Hex*	*ASCII*
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	[
92	5C	\
93	5D	]
94	5E	^
95	5F	—
96	60	'
97	61	a
98	62	b
99	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	¦
125	7D	}
126	7E	~
127	7F	DEL
128	80	
129	81	
130	82	
131	83	
132	84	
133	85	
134	86	
135	87	
136	88	
137	89	
138	8A	
139	8B	
140	8C	
141	8D	
142	8E	
143	8F	
144	90	
145	91	
146	92	
147	93	
148	94	
149	95	
150	96	
151	97	
152	98	
153	99	

■ **Note:** Decimal numbers 128 through 255 (hex 80 through FF) have no ASCII equivalents.

(continued on next page)

Decimal/Hexadecimal/ASCII Conversion Chart (continued)

Decimal	*Hex*	*Decimal*	*Hex*
154	9A	205	CD
155	9B	206	CE
156	9C	207	CF
157	9D	208	D0
158	9E	209	D1
159	9F	210	D2
160	A0	211	D3
161	A1	212	D4
162	A2	213	D5
163	A3	214	D6
164	A4	215	D7
165	A5	216	D8
166	A6	217	D9
167	A7	218	DA
168	A8	219	DB
169	A9	220	DC
170	AA	221	DD
171	AB	222	DE
172	AC	223	DF
173	AD	224	E0
174	AE	225	E1
175	AF	226	E2
176	B0	227	E3
177	B1	228	E4
178	B2	229	E5
179	B3	230	E6
180	B4	231	E7
181	B5	232	E8
182	B6	233	E9
183	B7	234	EA
184	B8	235	EB
185	B9	236	EC
186	BA	237	ED
187	BB	238	EE
188	BC	239	EF
189	BD	240	F0
190	BE	241	F1
191	BF	242	F2
192	C0	243	F3
193	C1	244	F4
194	C2	245	F5
195	C3	246	F6
196	C4	247	F7
197	C5	248	F8
198	C6	249	F9
199	C7	250	FA
200	C8	251	FB
201	C9	252	FC
202	CA	253	FD
203	CB	254	FE
204	CC	255	FF

■ **Note:** Decimal numbers 128 through 255 (hex 80 through FF) have no ASCII equivalents.

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2600 Series XL PAD
User's Guide
Part No. 08567, Rev B
April 1988

USER QUESTIONNAIRE

Thank you for taking the time to complete this survey. Codex products serve customers who have a wide range of data communications experience. We want our documentation to match our customers' experience and needs. Your responses to this survey will help us meet this goal. Using a scale of 1 to 5, with 5 representing the highest (most favorable) rating, please circle the number that reflects your response. Leave blank if question is not applicable to your manual.

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Are the operating instructions clear and complete?		1	2	3	4	5	
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How clearly are terms or concepts defined or explained?		1	2	3	4	5	
How well is the manual organized?		1	2	3	4	5	
How clear are the tables?		1	2	3	4	5	
Are the definitions in the glossary clear?		1	2	3	4	5	
Is the artwork clear and easy to understand?		1	2	3	4	5	
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How helpful is the index?		1	2	3	4	5	
Are the design applications examples helpful?		1	2	3	4	5	
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____

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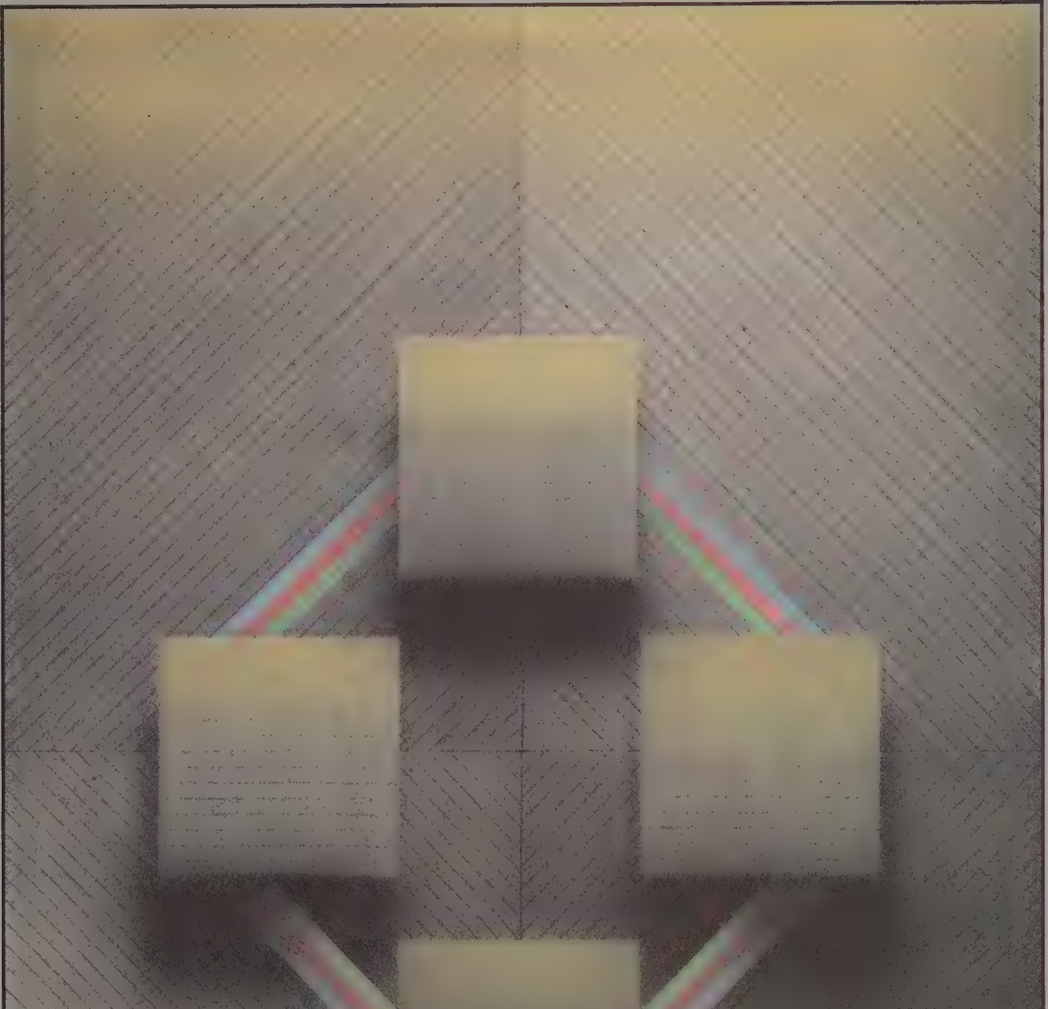

2600 Series Encryption
User's Guide

CODEX

2600 Series Encryption User's Guide

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A prepaid user questionnaire is provided in the back of this manual for your comments. Codex welcomes your comments; your input is important in helping us improve the effectiveness of this manual. Thank you.

WARNING

This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

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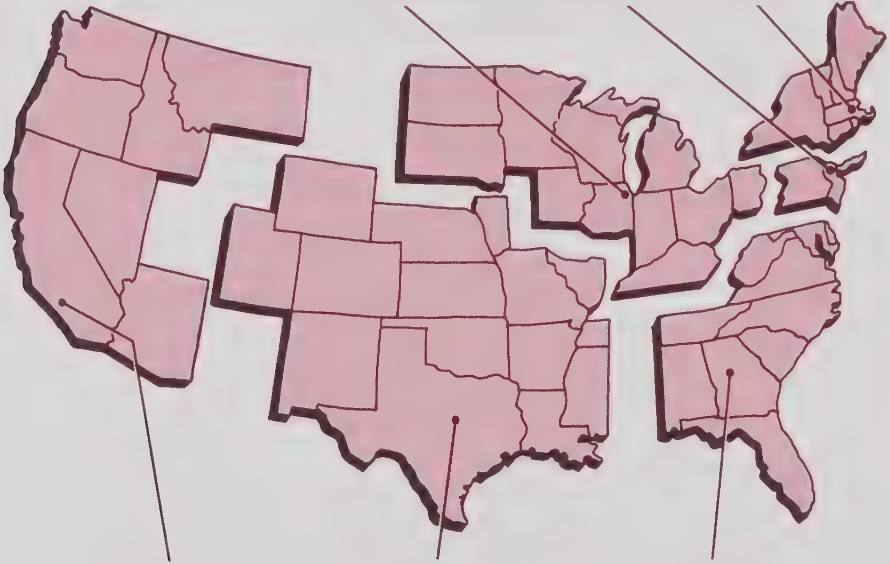
Codex Customer Service

This User's Guide has been written to help you understand, install, and use your Codex product. For further technical assistance, please contact the Codex Customer Service office in your area during normal business hours. Use the map below to determine the telephone number to call.



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ATLANTA
REGION
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Contents

Preface vii

Chapter 1. Introduction

General 1-1
Link Encryption with 2600 Series Modems 1-2
Data Encryption Keys and the DES Algorithm 1-2
Single-Bit Cipher Feedback 1-4
Creating Keys 1-4
  Creating the Root Key 1-5
  Creating and Changing Session Keys 1-6
Security Precautions 1-6
Features Summary 1-7

Chapter 2. Installation and Applications

Overview 2-1
Compatibility with Other Codex Products ... 2-2
Installation 2-2
  2600 Series Modem with Encryption Preinstalled 2-2
  Field Installation 2-3
Point-to-Point Encryption Networks 2-6
  Point-to-Point Encryption Networks with NMS 2-6
  Point-to-Point Encryption Networks without NMS 2-7
Multipoint Encryption Networks 2-8
  Multipoint Encryption Networks with NMS 2-8
  Multipoint Encryption Networks without NMS 2-9

Chapter 3. Configuration and Key Management

General 3-1
Loading Keys 3-2
  Root Key Entry with the Modem Loader 3-2
  Manual Root Key Entry 3-3

Contents (continued)

Chapter 3. Configuration and Key Management (continued)

ENCRYPT* Category 3-4
  EC PSW 3-5
  CHG KEY 3-5
  UNKEYED 3-6
  KEYED 3-6
  INJ LDR 3-7
  ENTR RK 3-9
  ZEROIZE 3-10
  CHG PSW 3-11
Error and Alert Messages 3-12
  Error Messages 3-12
  Alert Messages 3-13

Chapter 4. Status, Tests, and Diagnostics

General 4-1
Power-Up Diagnostic Messages 4-2
Test Tree 4-2
Status Tree 4-4
  EC STAT* Category 4-5
  DIAGNOS* Category 4-6
Special Service Requirements 4-8

Glossary

Index

Preface

The Encryption Option for 2600 Series Modems enables you to send secure, encoded data over the audio links between your modems. The Encryption Card is installed in the top expansion slot in a 2600 Series Modem to encrypt and decrypt the data for up to six terminal ports at each site. This user's guide describes how to configure and use the Encryption Option to create a secure data communications network. It is assumed that you have already read the Codex *2600 Series Modem User's Manual* and that you have some familiarity with 2600 Series Modems. This user's guide is divided into four chapters:

Chapter 1 is a general overview of encryption for data communications networks and the features offered with the 2600 Series Encryption Option. Security precautions for your 2600-based network are also detailed.

Chapter 2 describes the installation of your Encryption Option and shows how the option can be used in different types of data communications networks.

Chapter 3 leads you through the configuration of your Encryption Option and gives step-by-step instructions on how to perform key changes.

Chapter 4 describes the new diagnostic messages that can be generated when the Encryption Option is installed and also teaches you how to monitor all the Encryption-equipped modems in your network.

Chapter 1
Introduction

Contents

General 1-1
Link Encryption with 2600 Series Modems 1-2
Data Encryption Keys and the DES Algorithm 1-2
Single-Bit Cipher Feedback 1-4
Creating Keys 1-4
  Creating the Root Key 1-5
  Creating and Changing Session Keys 1-6
Security Precautions 1-6
Features Summary 1-7

GENERAL

Although the Encryption Option can be installed in several types of networks, these networks have one requirement in common: the need for secure, confidential data communications. The normal user of encryption is a financial institution, insurance company, defense contractor, government agency, or any other business with a need to maintain confidentiality in its data communications. As a user of the 2600 Series Encryption Option, you have identified this need for security in your own network. This guide explains how to use the Encryption Option in your network and describes the functionality the option adds to your 2600 Series Modem.

This chapter introduces basic concepts of data encryption and data communications security precautions for 2600 Series Modems. It also summarizes the features of the 2600 Series Encryption Option. After reading the description of how encryption works in the 2600 Series, you may wish to refer to the Glossary supplied with this guide for brief explanations of the terms described in this and other chapters.

LINK ENCRYPTION WITH 2600 SERIES MODEMS

The Encryption Option can be ordered for most of the 2600 Series Modems; it permits you to encrypt and decrypt data for up to six mux channels/terminals from a single modem. Unlike some other data security methods, the Encryption Option provides link protection. The data transmitted on the audio link between two 2600 Series Modems equipped with the Encryption Option appears to be a random, scrambled bit stream if it is demodulated. The encrypted data cannot be interpreted even if a dedicated ''adversary'' monitors or intercepts the transmission. See Figure 1-1 for a simplified example of encryption with 2600 Series Modems.

DATA ENCRYPTION KEYS AND THE DES ALGORITHM

The Encryption Option uses data encryption keys (coded patterns of 64 bits) to change unencrypted data (clear text) into encrypted data. Throughout this document, these data encryption keys are referred to as Session Keys because they are changed frequently, effectively splitting your data communications into ''sessions,'' where the data in each session is affected by a different Session Key. The Session Keys are internally generated by the EC (Encryption Card) hardware, stored in secure memory, and used in combination with an algorithm to transform the incoming bit stream into encrypted or decrypted data. The Encryption Option uses the Data Encryption Standard (DES) algorithm developed by the National Bureau of Standards (NBS) in combination with the Session Key as shown in Figure 1-2.

The EC electronically changes and coordinates the Session Keys that encrypt your data. You can thereby avoid the potential expense of frequent manual key distribution with its attendant risks including theft, copying, and loss of keys.

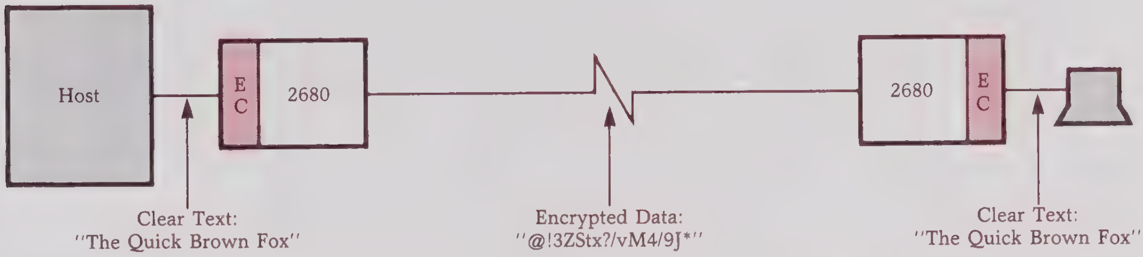

Host
E
C
2680
2680
E
C
Clear Text:
"The Quick Brown Fox"
Encrypted Data:
"@!3ZStx?/vM4/9J*"
Clear Text:
"The Quick Brown Fox"

Figure 1-1. Link Data Encryption

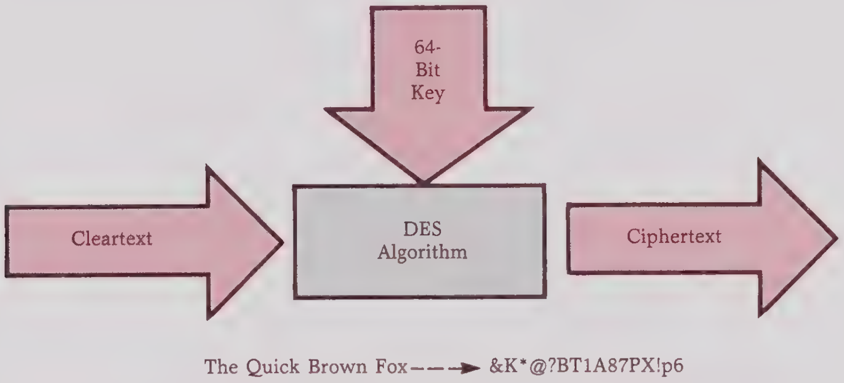

64-
Bit
Key
Cleartext
DES
Algorithm
Ciphertext
The Quick Brown Fox ——→ &K*@?BT1A87PX!p6

Figure 1-2. The Encryption Process

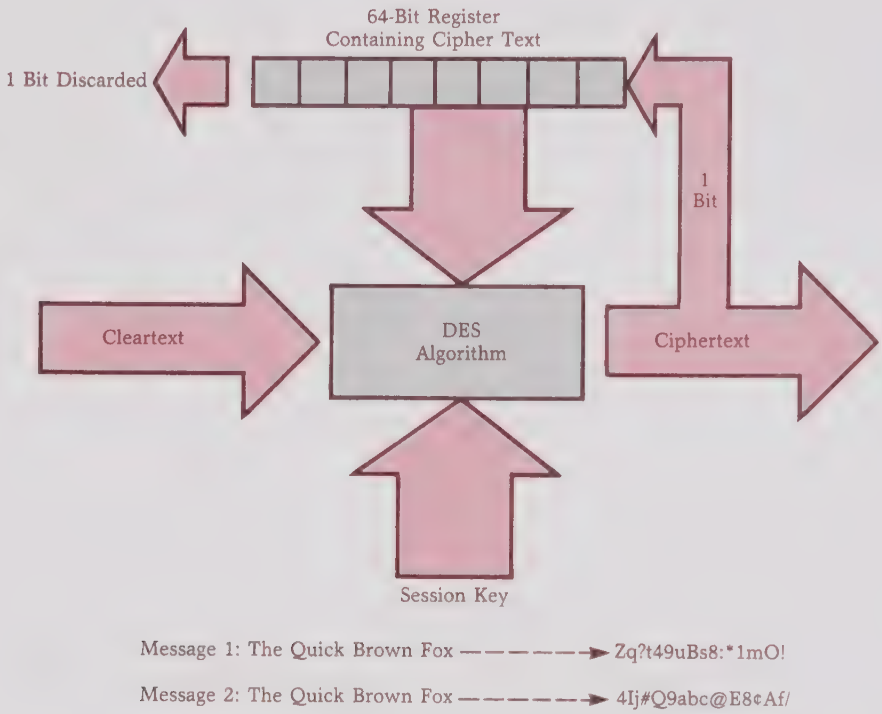

64-Bit Register
Containing Cipher Text
1 Bit Discarded
1
Bit
Cleartext
DES
Algorithm
Ciphertext
Session Key
Message 1: The Quick Brown Fox ——————→ Zq?t49uBs8:*1mO!
Message 2: The Quick Brown Fox ——————→ 4Ij#Q9abc@E8¢Af/

Figure 1-3. Single-Bit Cipher Feedback

SINGLE-BIT CIPHER FEEDBACK

Each bit of clear text entering the Encryption Card is acted upon by the 64-bit Session Key, a special register containing previously processed text, and the DES algorithm. The encrypted output text is continuously shifted back to the special register one bit at a time. This single-bit cipher feedback method of encryption is used to continuously change the output from the EC for a given character sent from the local DTE. For example, if the character **A** is sent initially, it might be encrypted so that it looks like the character **$** as it goes out of the EC. Due to the bit feedback encryption technique, the next time the character **A** is sent by the local DTE to the EC, the output from the EC to the network may look like the character #. Since the process is exactly reversed at the other end of a link, two Encryption Options synchronize without operator intervention. See Figure 1-3 for an example of how the DES, Session Key, and single-bit cipher feedback work together to encrypt and decrypt data.

CREATING KEYS

The electronically generated, 64-bit data encryption keys the Encryption Option uses to encrypt and decrypt data are called Session Keys because they are changed frequently, often hourly or daily. Session Keys are not manually programmed into the EC; rather, they are created in a secure process that ensures that the Session Key remains secret to all modem users, including yourself.

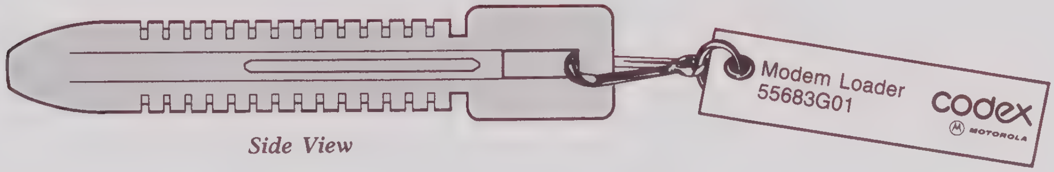


Figure 1-4. The Modem Loader

Prior to generating a Session Key, you must manually load a Root Key into each modem in the network line requiring secure operation. The Root Key is also a 64-bit key, but it protects the Session Key rather than user data, helping to ensure that the Session Key remains secret. The same Root Key must be manually loaded into each modem on a network segment in order to send and receive secure data on that segment. Since you must visit each modem to load Root Keys into their respective Encryption Cards, the keys are normally loaded when the Encryption Options in your network are initialized. Thereafter, you may wish to change Root Keys when scheduled maintenance is performed, or at relatively long intervals (perhaps annually).

Creating the Root Key

The Root Key can be created in two ways. Although the Session Keys that will be generated from Root Keys are secret for either method, the first method is preferred because the person loading the Root Key does not know what the bit code for the Root Key is. Both methods for creating the Root Key are described below.

Creating Root Keys with the Codex 9802 Key Programmer. Using the 9802 Key Programmer to create a Root Key is the most secure method because the bit code for the key is not revealed when the key is created. Following the instructions in the *Codex 9802 Key Programmer User's Guide*, you can use a Codex 9802 Key Programmer to electronically transfer a Root Key onto a Modem Loader (see Figure 1-4), and then follow the procedures for loading the Root Key into each modem prior to creating or changing a Session Key. The procedure for automatically loading the Root Key into the EC with the Modem Loader is fully described in Chapter 3 of this guide.

Creating the Root Key Manually The second method for creating a Root Key requires that you select 16 hexadecimal characters. The 16-character Root Key you choose is entered at each modem's front panel. Since the Root Key will be known to you and can be observed by anyone watching the front panel as you are entering the key, the possibility of key disclosure exists. Manual creation of the Root Key is therefore recommended only when the 9802 Key Programmer and Modem Loader(s) are not available for use.

To enter the Root Key manually in each modem, you must access the ENCRYPT* category in the Configuration Tree and scroll down to the ENTR RK subcategory. You must then choose 16 hexadecimal digits and enter them 8 digits at a time. The same Root Key must be entered in each modem on a network segment in order to transmit and receive secure data.

It is important to note that you are prevented from using the Remote Tree to pass the Root Key value to remote modems in your network: doing so would risk exposure of the secret key value. Since you cannot use the Remote Tree to enter a Root Key at each modem in your network, manual Root Key entry must be performed at each modem site. For a more detailed description of the manual Root Key creation procedure, see Chapter 3.

Creating and Changing Session Keys

Once you have loaded a Root Key into each modem on a line you have selected for secure operation, Session Keys may be generated in each modem to encrypt and decrypt the data to be transmitted on the line. Session Keys may be generated in two ways with the EC option:

- For each network line, you can use the modem closest to your host computer at the central site to send a "change key" command to the other modems on the line. Throughout this document, when a modem is used to enter the CHG KEY parameter (commanding key changes in other modems downstream) that modem is referred to as an encryption master modem.
- You can use a Codex Network Management System (NMS) to cause Session Key changes on any segment of a line by sending a command from the NMS to the EC-equipped modems. The procedures for issuing change key commands are fully described in an addendum to the user's manual for your specific NMS.

As you create or change a Session Key, each modem in a network segment generates a random 4-digit session number used to verify that each modem in a segment has the same Session Key. To initiate this verification procedure, you can use the EC STAT* category in the Status Tree to scroll down to the NUM *xxxx* subcategory. The 4-digit number displayed after you press the ||▶ key must be the same for all modems in a segment in order to transmit and receive secure data. You can perform this procedure for a remote modem with Encryption by using the REMOTE key on the front panel of the local modem to access the EC STAT* categories in other modems on the network segment or line.

SECURITY PRECAUTIONS

Although the 2600 Series Encryption Option is engineered to provide complete security for your data communications, *you* are responsible for the security of your network. As in any encryption system based on the DES, keys are the weak link in the total security system and must be strictly managed. In addition, you must make sure that only authorized users have access to the Encryption-equipped modems at each site. Codex also recommends the following procedures to increase the security of your network:

- Change the modem and ENCRYPT* category passwords from their default settings. Memorize the new passwords or record them and store them securely.
- Use Modem Loaders programmed by the 9802 Key Programmer whenever possible.
- Store Modem Loaders in a secure manner. Zeroize (erase) loaders whenever you are finished using them. Do not store unzeroized Modem Loaders in the modem.
- Select UKD STBY (unkeyed standby) for the unkeyed state and SECURE for the keyed state to prevent accidental transmission of clear text (see Chapter 3).
- Perform frequent Session Key changes. Depending on the sensitivity of your data, you may want to change Session Keys daily or even more frequently.

FEATURES SUMMARY

The following list of features summarizes the unique encryption functions provided by the 2600 Series Encryption Option.

Feature	*Benefit*
2600 Series Integration	Easily installed in 2600 Series Modems already present in your network, reducing expense and space requirements. Continuously encrypts and decrypts the data for up to six multiplexer channels/DTEs.
Hardware-Based Encryption	Encrypts/decrypts data with DES algorithm resident in application-specific integrated circuit. Special hardware lockout prevents inadvertent transmittal of key information.
Self Tests	Encryption hardware and software are tested during power-up (or on-line if selected from the front panel).
Electronic Key Changes	Eliminate operational expense and possible theft or copying of mechanical Session Keys. Allow for remote key changes from NMS or another 2600 Series Modem with Encryption. Weak keys are automatically rejected.
Tamper Resistance	Uses electronic keys in combination with the DES and single-bit cipher feedback. Configuration Tree and ENCRYPT* category are protected with separate passwords. All keys are zeroized if EC is removed.
Protocol Transparency	Works with asynchronous or synchronous DTEs and all protocols that are 2600 Series compatible. Functions at all transmission speeds, up to and including 19.2 kbps.
Transmission Continuity	Can pass clear text if user selects bypass mode. Encryption keys and password are protected by a dedicated backup battery in case of AC power loss.

Chapter 2
Installation and Applications

Contents

Overview 2-1
Compatibility with Other Codex Products ... 2-2
Installation 2-2
  2600 Series Modem with Encryption Preinstalled 2-2
  Field Installation 2-3
Point-to-Point Encryption Networks 2-6
  Point-to-Point Encryption Networks with NMS 2-6
  Point-to-Point Encryption Networks without NMS 2-7
Multipoint Encryption Networks 2-8
  Multipoint Encryption Networks with NMS 2-8
  Multipoint Encryption Networks without NMS 2-9

OVERVIEW

The Encryption Option is available for use in most Codex 2600 Series Modems. It can be ordered from the factory as an integral option or field-installed in a 2600 Series Modem already present in your network. The Encryption Option can be used in a number of applications, including point-to-point, multipoint, multi-tiered, and NMS-controlled networks. This chapter gives you information on compatibility with other Codex products and also describes installation of your Encryption Card (EC). Finally, several applications are illustrated to give you an indication of how the Encryption Option can be used in your own network.

COMPATIBILITY WITH OTHER CODEX PRODUCTS

The Encryption Option is available for the following 2600 Series Modems used in point-to-point and multipoint networks, with application restrictions as noted.

- 2680
- 2660
- 2650
- 2640 — Except CS48FP-S Operating Mode
- 2620 — Except CS48FP-M and CS48FP-S Operating Modes

It can also be combined with other 2600 Series options, with application restrictions as noted:

- Dual Dial Restoral (DDR)
- Enhanced Dual Dial Restoral (EDDR)
- Communications Test Equipment (CTE) — The RDS feature is disabled when Encryption and CTE are combined because RDS would compromise secure operation. ■ **Note:** None of the above options can be combined with the Encryption Option in a 2680 Modem because there are not enough PC board slots. You can obtain DDR functions for an Encryption-equipped 2680, however, by adding a Codex 2010 Dual Dial Backup Unit to your installation.

Products in the 2600 Series that *cannot* currently be ordered with the Encryption Option include the following:

- 2602 2-modem nest
- 2608 8-modem nest
- 2630 Dual multipoint modem

Key changes for the Encryption Option can be initiated from the following Codex Network Management Systems:

- 9300 Series
- 4800 Series

If you have a 2600 Series product or NMS that has not been mentioned in this section, please contact your Codex Customer Service Representative to determine compatibility with the Encryption Option.

INSTALLATION

The Encryption Option is available in two versions: as an integral option installed in a new 2600 Series Modem at the factory, or as a separate XL card and associated firmware for field installation. Installation instructions for the two versions are described in the following sections and referred to throughout this document.

2600 Series Modem with Encryption Preinstalled

The site installation procedures for a 2600 Series Modem with the Encryption Option preinstalled at the factory are the same as those described in Chapter 5, Installation and Troubleshooting, in the *2600 Series Modem User's Manual*. Note that the modem will not pass secure data until the Encryption Option has been properly configured and keyed. You may, however, continue to send clear text (unencrypted data) if you enter the UKD BYP selection for the unkeyed state (see Chapter 3). No other special considerations apply to installation of a modem with the Encryption Option already present, except that the modem should be installed in a secure location with limited access.

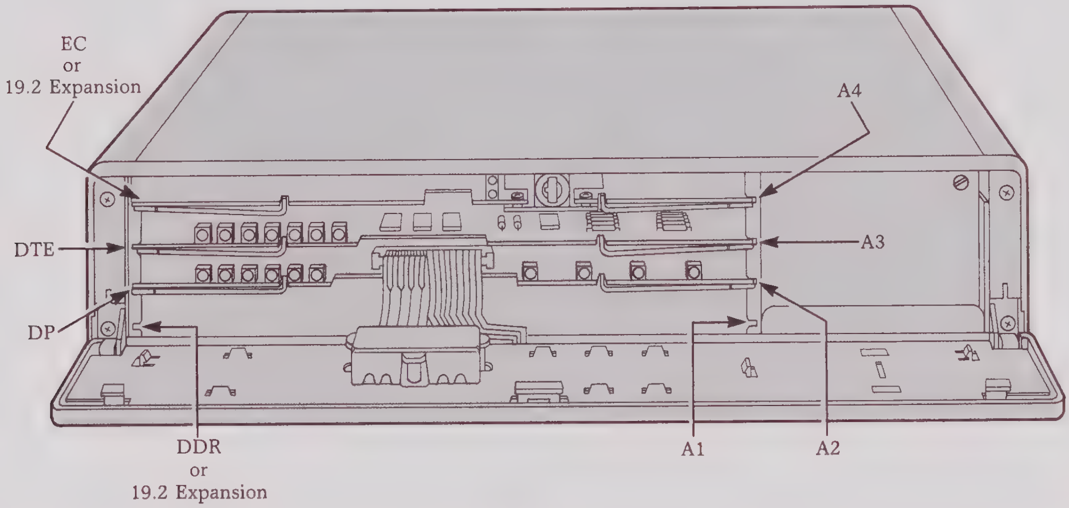


Figure 2-1. Front View with Control Panel Down

After the modem with the EC is installed on-site and you find it necessary to reseat or replace the Encryption Card, refer to Chapters 6 and 7, Maintenance and Return Procedures, in the *2600 Series Modem User's Manual*, but consult Figure 2-1 for the location of the EC in the A-4 slot. Note that whenever you reseat or replace the EC, you erase (zeroize) all the encryption keys, and your modem will not be able to pass data securely until you rekey it.

Field Installation

The Encryption Option can be ordered in a kit for installation in 2600 Series Modems you already have in your network. Special requirements and instructions for installing the kit follow.

■ **CAUTION: IMPORTANT INSTALLATION NOTICE.** FAILURE TO ADHERE TO THE FOLLOWING INSTRUCTIONS MAY CAUSE EQUIPMENT MALFUNCTION THAT YOU WILL HAVE TO PAY TO HAVE CORRECTED.

In order to function properly, your 2600 Series XL Encryption Option requires that the DTE software release in the modem receiving the Encryption Option be Revision 18 or higher. Your Codex Customer Service Engineer can advise you whether your 2600 Series Modem has the required DTE software release level (generally requiring a site visit for which Codex's standard charges may apply).

Since your 2600 Series Modem may not have the required software release level, Codex includes a set of DTE PROMs containing the required software with your Encryption Option. If your 2600 Series Modem does not have the required DTE software release level, you should have a Codex Customer Service Engineer install the new DTE PROMs. If you try to install them yourself, you may cause equipment malfunction that you will have to pay to have corrected.

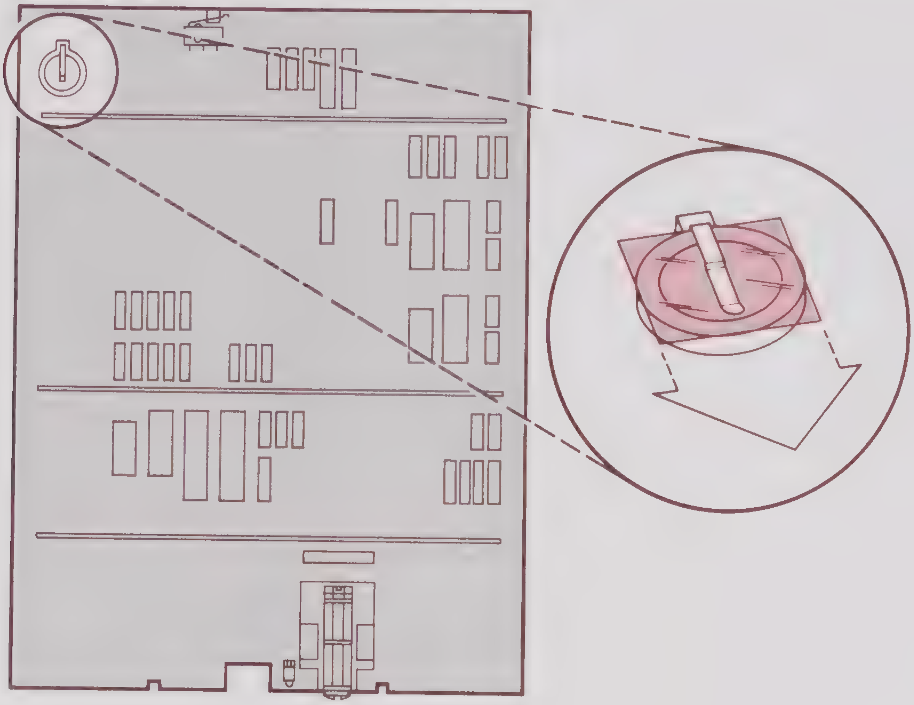


Figure 2-2. Removing the Battery Protector

Prior to installing the EC (Encryption Card), refer to Figure 2-1 to familiarize yourself with the card's required location. If you have a 2680 Modem with the DDR, EDDR, or CTE option already installed, there are not enough free PC card slots left to install the Encryption Option. If you wish to install both DDR/EDDR and Encryption, you should consider placing the Encryption Option in the modem and replacing the DDR/EDDR card with a standalone Codex 2010 Dual Dial Back-Up unit. Doing so requires removing the DDR/EDDR card from slot A1, switching the 19.2 Expansion Card from slot A4 to A1, and installing the EC in slot A4.

Follow the steps outlined below to install your new Encryption Card when the DTE card in your modem has a revision level of 18 or higher.

1) Unwrap the EC from the anti-static bag and remove the rectangular plastic film from between the battery and its contact (see Figure 2-2). The plastic film must be removed to allow the battery for the EC backup memory to function. The plastic film prevents battery power from being drained by the anti-static bag during shipment and storage.

WARNING

Do not dispose of the battery in a fire or immerse the battery in liquid. Do not recharge or solder the battery or reverse its polarity (install it upside-down). Failure to observe these precautions may cause the battery to explode or leak, possibly causing personal injury.

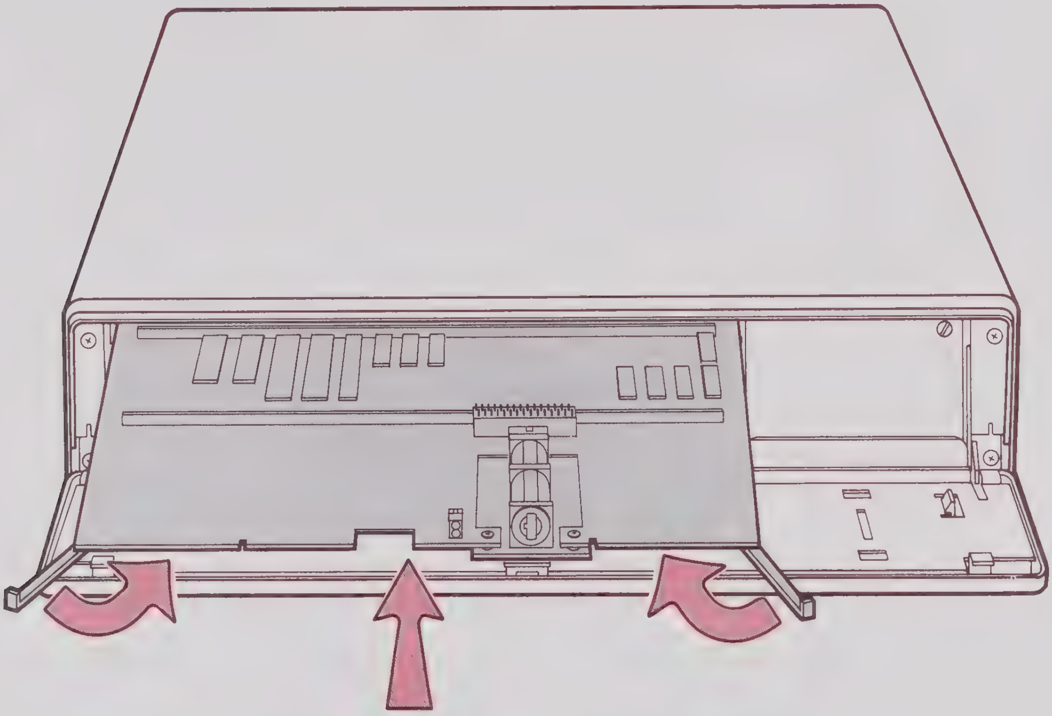


Figure 2-3. Inserting the EC Card

2) Make sure the AC power cord for the modem is not plugged in and that the modem power is off. Open the modem's front panel.

3) Hold the card extractors/inserters at each front corner of the EC and slide the card gently into the A4 slot in the modem. (Refer back to Figure 2-1 for slot location.)

4) When the leading edge of the card meets resistance at the back of the slot, push the extractors/inserters inwards toward the EC board so that all connections are made and the board is fully seated (see Figure 2-3).

5) Close the modem front panel, plug the modem into an AC outlet, and power up the modem. Watch the front panel display to make sure the modem passes the power-up diagnostic tests, and proceed to configure your modem. If the modem fails the power-up tests, turn the power off, reseat all the PC cards, and power up the modem again.

6) Configure and key your Encryption Option (see Chapter 3).

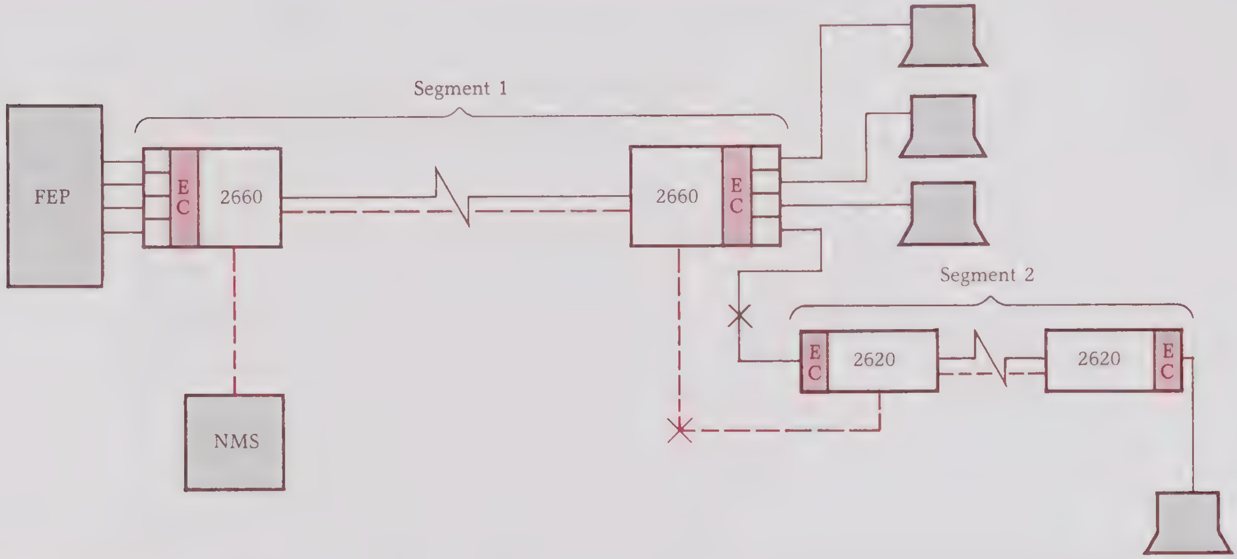


Figure 2-4. Point-to-Point Encryption Network with NMS

POINT-TO-POINT ENCRYPTION NETWORKS

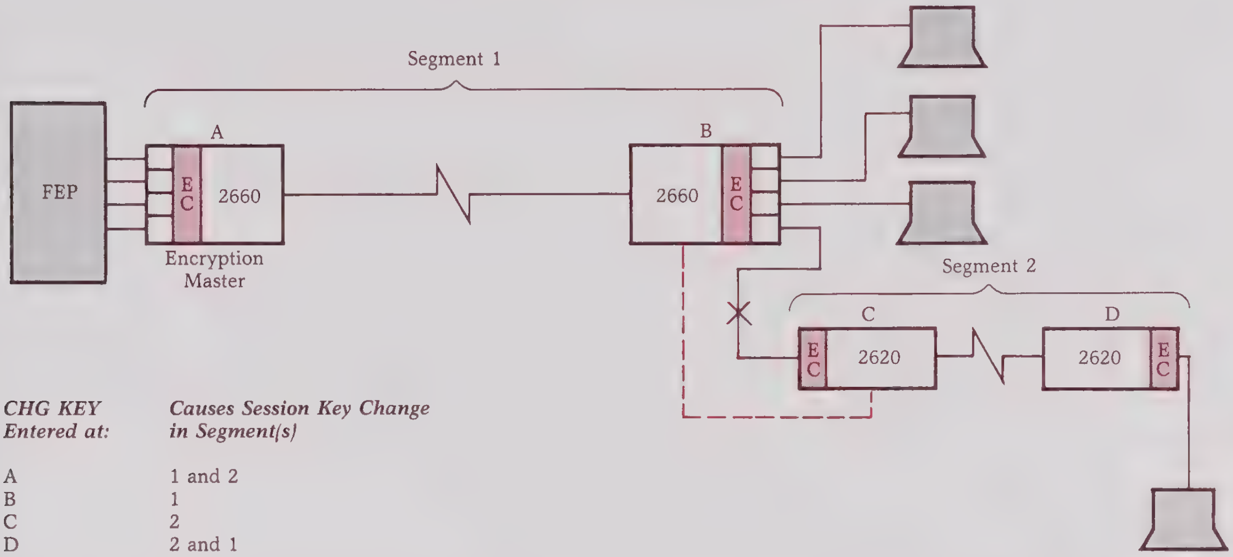
The Encryption Option can be used in all types of point-to-point applications, including multiplexed, MSU (Modem Sharing Unit), and tail circuit applications. Your encryption network can be monitored by a Codex NMS or a centrally located 2600 Series Modem that you designate as the encryption master modem. Some examples of these applications are described in this chapter.

In the following sections and throughout the remainder of this guide, the term ''segment'' is used to describe modems that communicate over an audio connection. This definition of a segment is drawn from Codex 4800 Series NMS terminology: the Codex 9300 Series NMS definition for the same entity is ''line.'' Throughout this guide, we will also adhere to 4800 Series conventions by describing a series of connected network segments as a ''line.''

Point-to-Point Encryption Networks with NMS

A basic point-to-point encryption setup with NMS monitoring modem functions and Session Key changes is shown in Figure 2-4. Once the Root Keys have been loaded into each modem in the network segment, you can use your NMS to perform Session Key changes and monitor the key change status on each segment. The NMS initiates key changes on a segment-by-segment basis only; initiating the key change command for one segment on a line does not affect any other segments that may be on the same line. See the addendum supplied with your NMS for further information on changing Session Keys.

Note that using your NMS to initiate key changes does not prevent you from using the front panels of your Encryption-equipped modems for key changes. Be aware, however, that you may cause a key change on more that one segment if you issue the command from a modem front panel. For detailed information on initiating front panel key changes, see the next section, Point-to-Point Encryption Networks without NMS.



CHG KEY Entered at:	Causes Session Key Change in Segment(s)
A	1 and 2
B	1
C	2
D	2 and 1

Figure 2-5. Point-to-Point Encryption Network without NMS

Point-to-Point Encryption Networks without NMS

In a simple point-to-point network without NMS, you can manage modem functions, monitor encryption status, and perform Session Key changes using a modem you designate as the encryption master. The encryption master is usually a modem located at your central site as close as possible to the FEP, although in a point-to-point network either the local or the remote modem can function as the encryption master. In Figure 2-5, the modem labeled A is the encryption master.

If a line has two segments, as in the example shown in Figure 2-5, key changes initiated at the modems labeled A and D will cause key changes on both segments. Key changes initiated at modems B or C, however, will affect only segments 1 or 2, respectively. If you want to change keys for all the segments on a line, you can avoid confusion by using the modem at your central site (modem A in the illustration) as a master encryption modem from which you will initiate all key changes for the line. Regardless of where the key change is issued, the Session Keys for each segment will always be different (even if generated from the same Root Key).

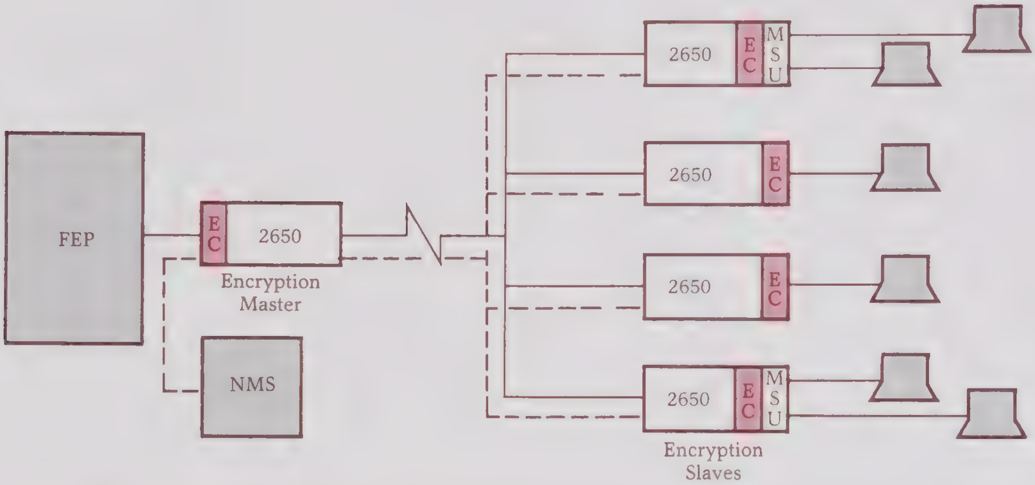


Figure 2-6. Multipoint Encryption Network with NMS

MULTIPOINT ENCRYPTION NETWORKS

The Encryption Option can be used in any of the Codex 2600 Series multipoint modems, including the 2620, 2640, and 2650. The CS48FP operating modes available in the 2620 and 2640 cannot be used with the Encryption Option, but the option is compatible with all other 2600 Series multipoint features, including Multipoint Signal Quality Binning (MSQB), MSU, Train On Data (TOD), Cry For Help (CFH), and Mixed Inbound Rates (MIR). See the examples in the remainder of this chapter for illustrations of multipoint encryption networks with some of these features.

Multipoint Encryption Networks with NMS

A basic multipoint encryption setup with an NMS monitoring all modem functions and changing encryption keys is shown in Figure 2-6. Once the Root Keys have been loaded into each modem in the network segment, you can use your NMS to perform Session Key changes on each multipoint segment. See the addendum supplied with your NMS for further information on changing Session Keys.

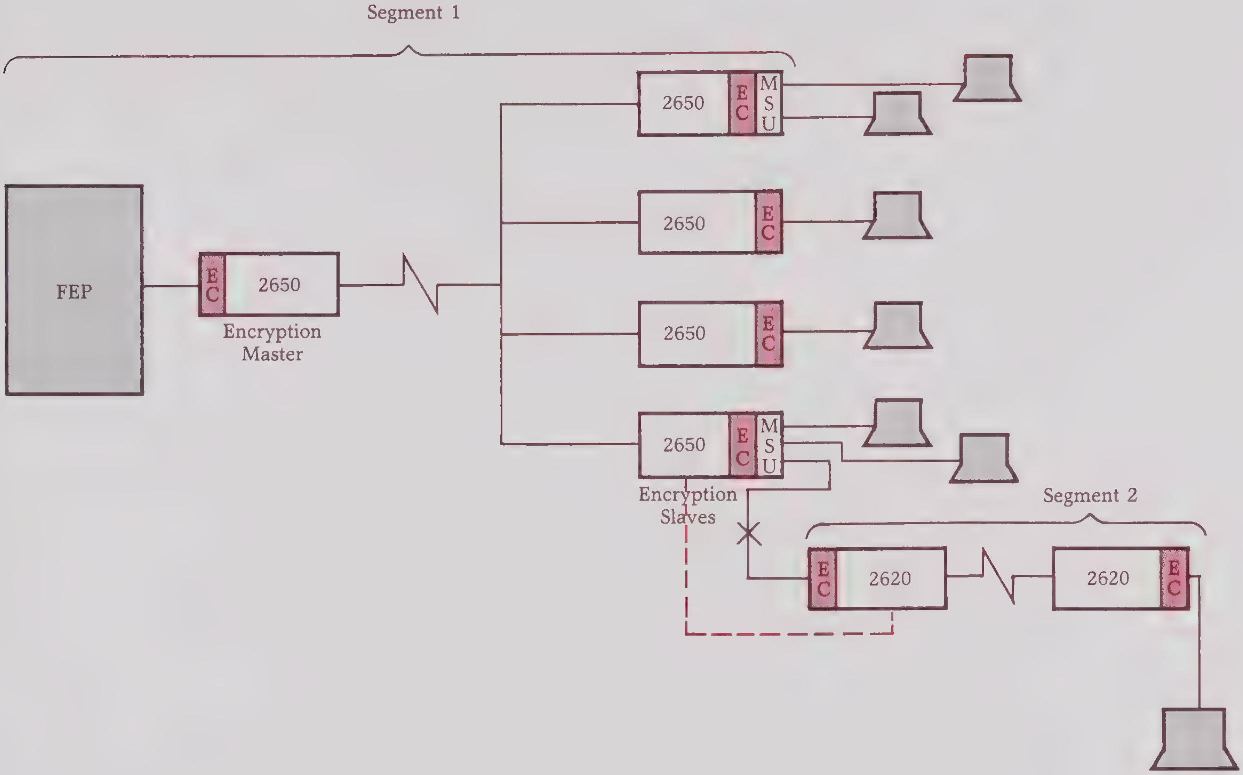

Segment 1
FEP
E C
2650
Encryption Master
2650
E C
M S U
2650
E C
2650
E C
2650
E C
M S U
Encryption Slaves
Segment 2
E C
2620
2620
E C

Figure 2-7. Multipoint Encryption Network without NMS

Multipoint Encryption Networks without NMS

When you are using encryption in a multipoint network without NMS, you must use the multipoint master as the master encryption modem. All Session Key changes and encryption status monitoring must be performed at the master encryption modem. Session Key changes cannot be performed from multipoint slave modems (those modems with operating modes MPMUX-S, HSMP-S, or MP-S enabled).

This feature ensures secure, centrally managed operation of your network. As described in the earlier example of a point-to-point network without NMS, you can also cause key changes in several segments in a line by entering the key change command at the encryption master modem. In the example shown in Figure 2-7, a change key command issued from the multipoint master would cause key changes in both segments 1 and 2.

Chapter 3
Configuration and Key Management

Contents

General 3-1
Loading Keys 3-2
  Root Key Entry with the Modem
    Loader 3-2
  Manual Root Key Entry 3-3
ENCRYPT* Category 3-4
  EC PSW 3-5
  CHG KEY 3-5
  UNKEYED 3-6
  KEYED 3-6
  INJ LDR 3-7
  ENTR RK 3-9
  ZEROIZE 3-10
  CHG PSW 3-11
Error and Alert Messages 3-12
  Error Messages 3-12
  Alert Messages 3-13

GENERAL

This chapter describes the procedures for configuring your Encryption Option, using Modem Loaders, and changing Session Keys. You should be familiar with basic modem configuration procedures as described in the *2600 Series Modem User's Manual* before configuring your Encryption Option. All Encryption Option configuration and key change functions are performed using the ENCRYPT* category in the Configuration Tree. You may only access the Configuration Tree locally by using the front panel of the modem you wish to configure. The Encryption Option cannot be configured remotely: this feature prevents an adversary from compromising the security of your network.

LOADING KEYS

There are two methods of beginning the encryption process. In both instances, you must load the same Root Key into both encryption modems on a network segment. As its name implies, the Root Key is used to create a secondary key called the Session Key. The Session Key is used to encrypt/decrypt your data and is normally changed daily, while the Root Key need only be loaded annually, when maintenance is done, or when you initially configure all the Encryption Options in your network.

Use either of the methods described in the next two sections to load the Root Key into your modem only after you configure the UNKEYED and KEYED subcategories in the ENCRYPT* category as described later in this chapter. The following methods for loading the Root Key are provided here for ease of reference during normal operation: all the Encryption Options in your network should be installed and configured first.

Root Key Entry with the Modem Loader

The keying method that provides the greatest security involves the use of Modem Loaders that are programmed by a Codex 9802 Key Programmer. The Key Programmer is used to "burn" or transfer coded bit patterns into a Modem Loader. The bit patterns burned into the Modem Loader consist of the Root Key and a Verification Constant (VC). The Modem Loader, in turn, transfers a copy of the Root Key and VC into each Encryption Option present in the network line you want encrypted.

Prior to loading Root Keys into the modems you are using for encryption, you may wish to select the UKD BYP (unkeyed bypass) setting from the UNKEYED subcategory. Performing this preliminary configuration allows you to send unencrypted data "in the clear" until your network is completely keyed.

The procedure for using a Modem Loader to load the Root Key into each modem in the network segment follows.

1) After reading the instructions in the Codex *9802 Key Programmer's Guide*, program a single Root Key/VC onto a Modem Loader that will be used to key all the Encryption Options in a network segment. You can also copy the Root Key/VC onto other Modem Loaders if several people will be keying Encryption Options in various locations simultaneously.

2) Proceed to the first modem into which you want to load the Root Key/VC and press the CONFIG key on the front panel until the ENCRYPT* Category is displayed.

3) Press the ▼ key until you reach the EC PSW subcategory. Use the ‖▶ and ADV # keys to enter the default encryption password 2126, or enter your own encryption password if you have changed the default previously. Press ENTER. The modem will respond with the message COMPLETE to signal that you may proceed with other subcategory selections.

4) Press the ▼ key until you reach the INJect LoaDeR subcategory and press the ‖▶ key. START is displayed.

5) Press the ENTER key and wait for the message INJect NOW to be displayed.

6) Flip down the modem's front panel and insert the pointed end of the Modem Loader into the receptacle in the center of the EC. The Modem Loader has a tab on one side that matches a slot in the receptacle. If you have trouble inserting the Modem Loader into its receptacle, remove the Modem Loader, turn it over, and reinsert it so that it is fully seated.

7) Make sure the green LED to the left of the receptacle is lit, then turn the Modem Loader to the right one quarter-turn. The red LED should flash momentarily while the Root Key and VC are being transferred from the Modem Loader to the Encryption Card's memory. When both LEDs are extinguished, turn the Modem Loader back to the vertical position and remove it. If the red LED stays lit after you have inserted the Modem Loader and turned it to the right, turn the Modem Loader back to the vertical position, remove it, and read the error message on the modem front panel. Consult Table 3-2 to interpret the error message, take corrective action, and start over with Step 4.

8) Close the front panel. If a Root Key and VC were present on the Modem Loader and copied to the modem correctly, COMPLETE is displayed on the front panel. You may then proceed to use the Modem Loader on other modems in your network or make other selections from the ENCRYPT* Category. If an error message (ERR xxx) is displayed, consult Table 3-2 for the cause of the error, perform the recommended action, and try the Root Key loading procedure again.

Manual Root Key Entry

The second method of loading a Root Key into your encryption modem does not involve the Modem Loader. Instead, you can enter the Root Key manually from the modem front panel, as though you are setting strap parameters. ■ **Note:** This method of loading the Root Key is normally used in an emergency when no Modem Loader is available. Codex does not recommend manual entry of the Root Key, because the user knows and can disclose it. Since a Modem Loader cannot be read and the Root Key it contains is encrypted, Root Key entry with the Modem Loader is the more secure and preferred method for Root Key loading.

To enter a Root Key manually, you must choose 16 hexadecimal digits and enter them 8 digits at a time. Perform the following steps to load a Root Key manually:

1) To reach the subcategory called ENTR RK, perform Steps 2 and 3 from the previous instructions for Root Key entry with the Modem Loader.

2) Press the ▼ key until you reach the ENTR RK subcategory.

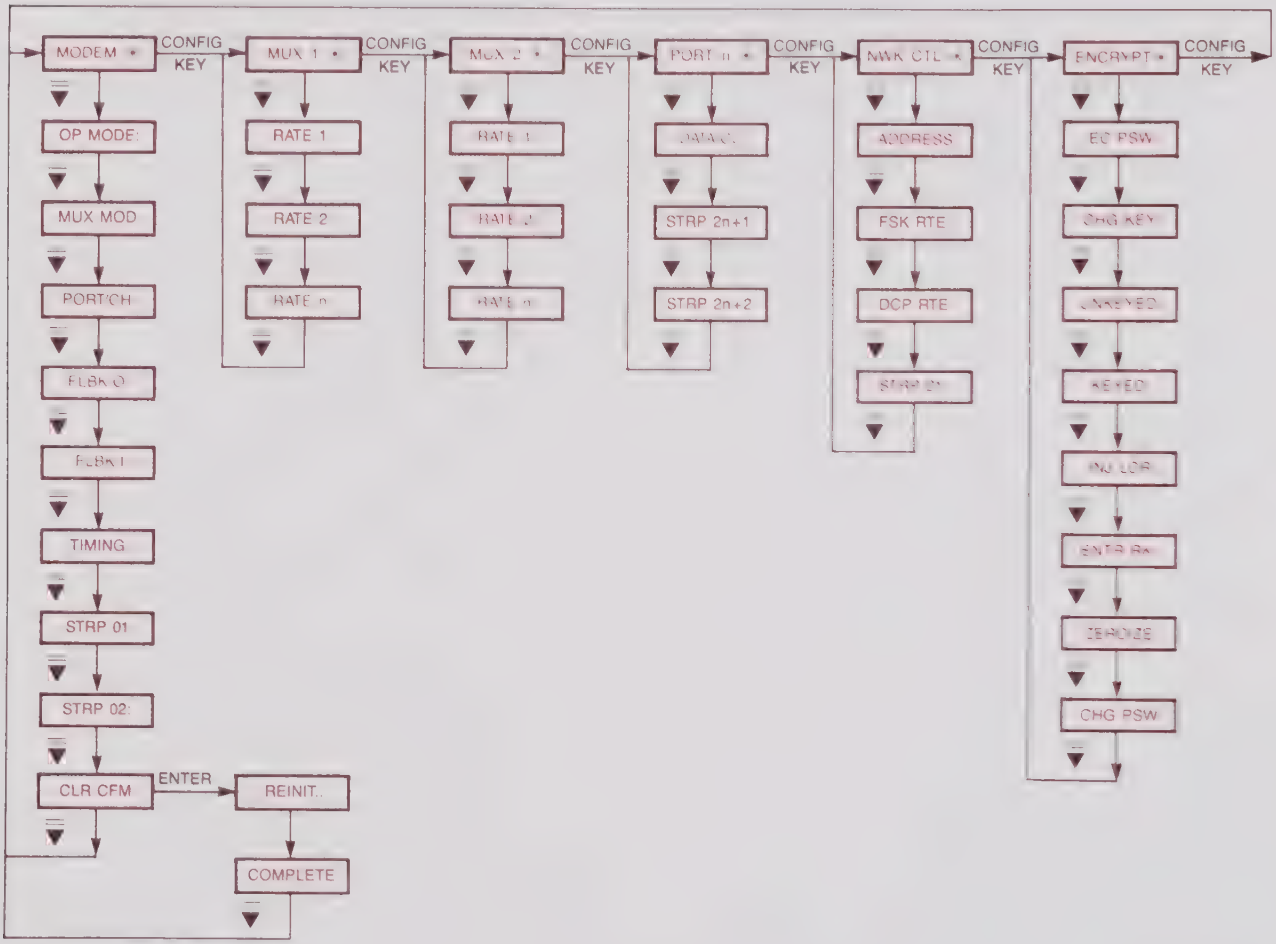
3) Press the ‖▶ key twice until 00000000 is displayed. Use the ADV # and ‖▶ keys to select eight hexadecimal digits (0-9, A-F) you want to designate as the left half of your Root Key, then press ENTER.

4) Press the ‖▶ key once and enter the right half of the Root Key, following the same procedure described in Step 3. Wait for the COMPLETE prompt to appear in the display before continuing to access other areas in the ENCRYPT* category. ■ **Note:** When entering a Root Key manually with the ENTR RK subcategory, make sure the Root Key you choose is not all zeroes or a weak (easily decoded) key like 01010101 01010101. The encryption software automatically prevents you from entering such a key by refusing your entry and displaying ERRor 107 to indicate an attempt to enter an "all zeroes" or weak key. See Table 3-1 for a partial list of weak keys.

As you manually enter the Root Key and continue to scroll downward through the ENCRYPT* Category, you may note that there is no subcategory where you can enter a Verification Constant (VC). Unlike the Modem Loader, which supplies its own VC, manual key entry does not require you to enter a VC. The Encryption Option has a default VC stored in memory that it will use when you choose to enter the Root Key manually.

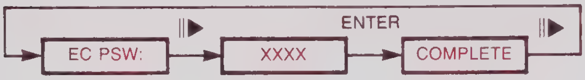
ENCRYPT* CATEGORY

The ENCRYPT* Category in the Configuration Tree contains all the encryption settings for the modem you are using. To access the ENCRYPT* category, press the CONFIG key repeatedly until the category title appears in the front panel display. You can then use the ▼ key to access the various subcategories shown below and described in the remainder of this chapter.


MODEM •
CONFIG KEY
MUX 1 •
CONFIG KEY
MUX 2 •
CONFIG KEY
PORT n •
CONFIG KEY
NWK CTL •
CONFIG KEY
ENCRYPT •
CONFIG KEY
OP MODE:
MUX MOD
PORT/CH
FLBK O
FLBK I
TIMING
STRP 01
STRP 02:
CLR CFM
ENTER
REINIT..
COMPLETE
RATE 1
RATE 2
RATE n
RATE 1
RATE 2
RATE n
DATA C
STRP 2n+1
STRP 2n+2
ADDRESS
FSK RTE
DCP RTE
STRP 21
EC PSW
CHG KEY
UNKEYED
KEYED
INJ LOR
ENTR RK
ZEROIZE
CHG PSW

EC PSW

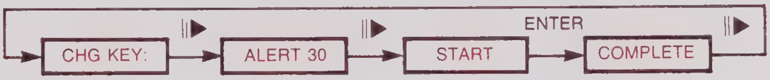
You must enter the encryption password to gain access to the other ENCRYPT* subcategories. The factory default password is 2126, but Codex recommends that you change it when you reach the CHG PSW subcategory at the end of the ENCRYPT* Category. Be careful while entering the password. If you enter an incorrect password three times, you are prevented from accessing the ENCRYPT* Category for 15 minutes.



CHG KEY

Once you have entered a Root Key with the Modem Loader or ENTR RK subcategory, you may generate or change Session Keys with this selection. You *must* generate the Session Keys prior to using modems in the secure state. You should only do this once *all* modems on a segment have the same Root Key. You should also make sure none of the modems that are to receive the key change have the OVERRIDE selection in the Remote Tree enabled, because modems overriding remote control ignore the change key command.

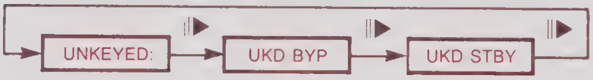
To verify the key generation or change, use the STATUS tree as described in the next chapter. ■ **Note:** The CHG KEY subcategory will not appear if the modem you are using has operating mode MP-S, HSMP-S or MPMUX-S enabled. For security reasons, slave modems in multipoint applications cannot control Session Key generation or changes.



UNKEYED

When your Encryption Option does not have a Session Key in effect, it is in the unkeyed state. This selection lets you determine if transmission of clear text will be allowed while the modem is in the unkeyed state. Select one of the following parameters for both modems in a segment:

- ***UKD STBY.*** The unkeyed standby selection is the factory default and will prevent the modem from transmitting user data while in the unkeyed state. When this mode is in effect and no key is present, the front panel Transmit Data (TXD) LED is not lit and the Modem Check test appears to fail if initiated. All other modem functions remain normal.
- ***UKD BYP.*** The unkeyed bypass selection will allow the modem to transmit and receive clear text (unencrypted data) while in the unkeyed state. You may wish to enable this selection during initial installation of the Encryption Option or when troubleshooting your network. Do *not* enter this setting if you want to ensure that only secure, encrypted data is transmitted and received.

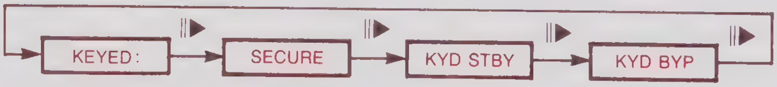


KEYED

When your Encryption Option has both a Root Key loaded *and* a Session Key in effect, it is in the keyed state. This selection allows you to determine what kind of data will be passed when the modem is in the keyed state. Choose one of the following:

- ***SECURE.*** Enter this parameter to ensure that your modem will transmit and receive only encrypted data while in the keyed state. SECURE is the factory default setting.
- ***KYD STBY.*** The keyed standby selection prevents the modem from transmitting user data while in the keyed state. When this mode is in effect and a key is present, the front panel Transmit Data (TXD) LED is not lit and the Modem Check test appears to fail if initiated. All other modem functions remain normal.
- ***KYD BYP.*** The keyed bypass selection allows the modem to transmit and receive clear text while in the keyed state. Do *not* enter this setting if you want to ensure that only secure, encrypted data is transmitted and received.

■ **Note:** When initially configuring your network, you may choose to select UKD BYP for the unkeyed state until all modems are keyed. You can then choose to change the setting for the unkeyed state to UKD STBY for greater security.



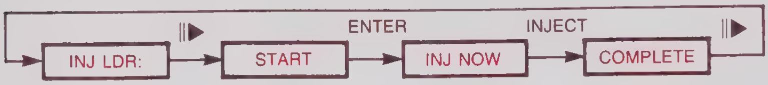
INJ LDR

Use this subcategory to coordinate the injection of the Modem Loader into the EC and subsequent loading of a Root Key and VC. ■ **Note:** For added security, there is a 30-second time limit for performing the steps after you press ENTER. Familiarize yourself with the entire procedure described below before attempting to insert the Modem Loader. If you do not insert the Modem Loader within 30 seconds, the EC retains its original Root Key, if it had one.

Make the following selections from the ENCRYPT* Category to prepare for insertion of the Modem Loader:

When the INJ NOW prompt is displayed on your screen, perform the steps shown in Figure 3-1. You have 30 seconds to complete the procedure.

When you have completed the steps in Figure 3-1 and closed the modem front panel, COMPLETE is displayed. You may proceed to configure other subcategories in the ENCRYPT* category by pressing the ▼ key.



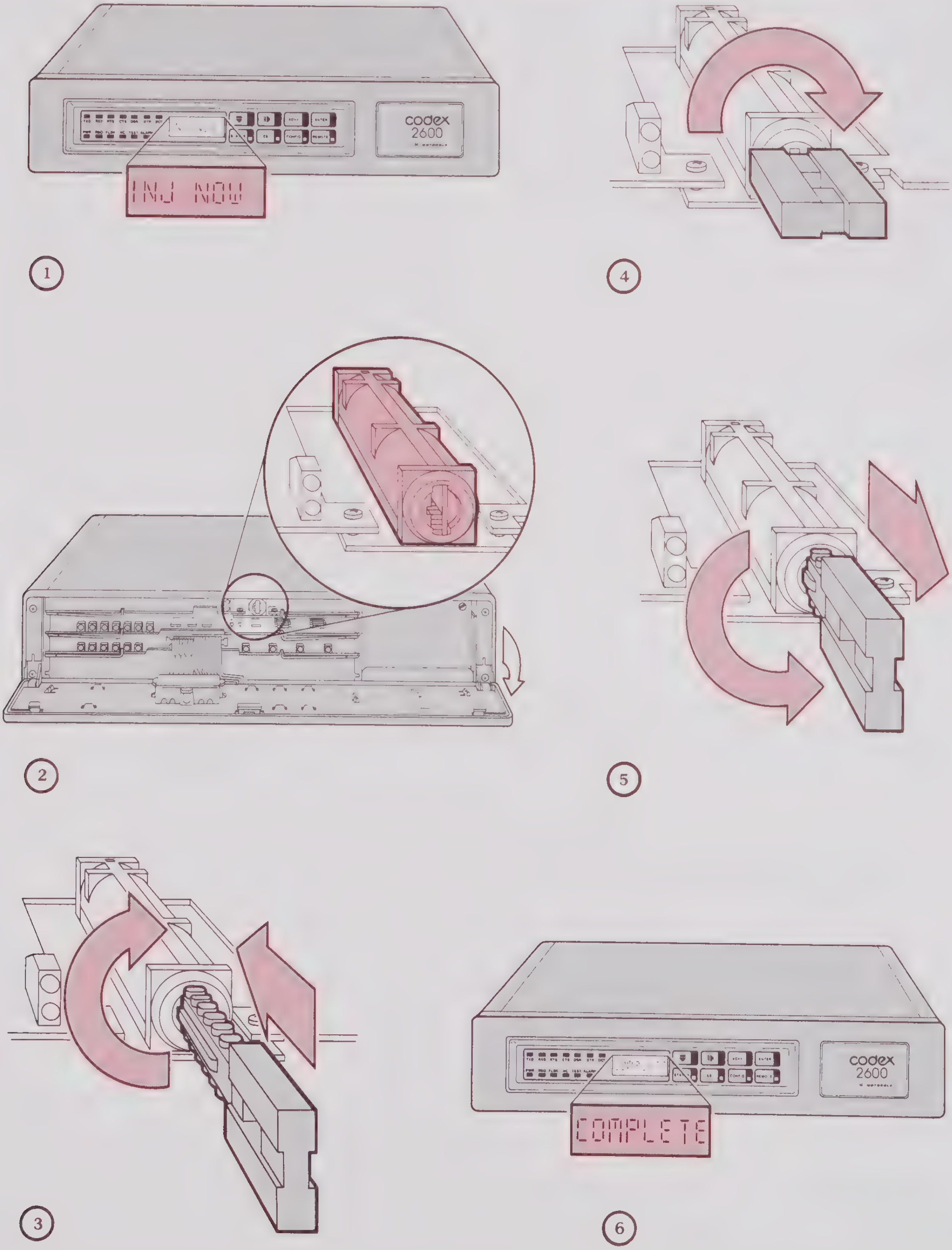

codex
2600
INJ NOW
①
④
②
⑤
③
codex
2600
COMPLETE
⑥

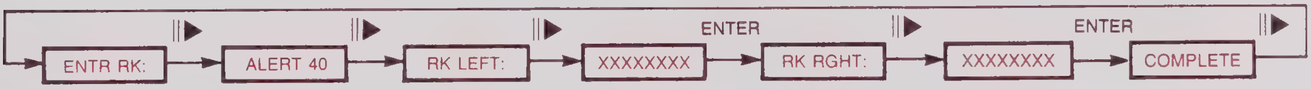
Figure 3-1. Inserting the Modem Loader

ENTR RK

This subcategory permits you to enter a Root Key by manually entering the hexadecimal digits that make up the key, rather than inserting a Modem Loader. The 16-digit Root Key is entered 8 digits at a time. After you manually enter the Root Key, the EC encodes your entry and checks it to make sure it is not a "weak" (easily decoded) key. When entering the Root Key manually, do not select a weak key. See Table 3-1 for examples of some common weak Root Keys: because one out of every eight bits is used for parity when the EC is processing keys, there are many other weak keys in addition to those listed. The encryption software returns the message ERRor 107 to indicate an attempt to enter a weak key or an "all zeroes" key.

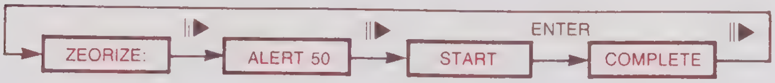
Table 3-1.
Common Weak Root Keys

RK LEFT:	*RK RIGHT:*
01010101	01010101
FEFEFEFE	FEFEFEFE
1F1F1F1F	0E0E0E0E
E0E0E0E0	F1F1F1F1



ZEROIZE

Use this subcategory to erase the current Session Key and Root Key. *Entering ZEROIZE disrupts all secure communications* and puts your modem in the unkeyed state. You are therefore warned by the message "Alert 50" and given the option to abort the process by pressing ▼. When you have completed zeroizing the current keys, the modem enters either the unkeyed standby (UKD STBY) or unkeyed bypass (UKD BYP) mode, depending on which mode you have selected for the unkeyed state. To resume secure communications, you must enter a Root Key with either the Modem Loader or ENTR RK subcategory, and use the CHG KEY subcategory to load new Session Keys throughout your network segment.



CHG PSW

For added security, use this subcategory to change the password for the ENCRYPT* category. Make sure to memorize or record the new password before entering it. If you do not change the password, the default password preset at the factory remains in effect. To verify that you have changed the password, press ⩡ until the EC PSW subcategory is displayed, and enter the new password.

■ **Note:** If you forget or lose a new EC password after you enter it, you cannot gain access to the ENCRYPT* category of the corresponding modem again unless you pull the EC and reseat it, thereby zeroizing all keys and re-establishing the default password. Once you have pulled the EC for one modem in a network segment, *a Root Key must be reloaded and Session Keys must be changed for all modems in the segment* before you can resume secure communications.

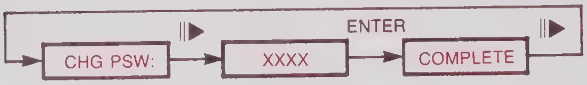


Table 3-2.
Control Panel Error Messages

Error Message	*Recommended Action*	*Definition*
ERR 101	Error detected in Modem Loader receptacle	Try Modem Loader injection procedure again
ERR 103	Modem Loader ID failure	Use a different Modem Loader
ERR 106	INJ LDR timer expired	After entering START, perform Modem Loader injection procedure within 30 seconds
ERR 107	Weak Key or ''all zeroes''	Consult Table 3-1 and enter a different Root Key
ERR 120	Invalid ENCRYPT* password	Enter the correct password
ERR 121	Password retry limit exceeded	(1) Wait 15 minutes, or (2) pull the EC, re-key both modems in the segment, then enter default password
ERR 122	No Root Key present or NMS key change in progress	Load RK or wait for NMS to finish key change
ERR 123	Key change prohibited. Local modem is under remote modem control.	Check with remote sites
ERR 125	Encryption hardware failure	Call Codex Customer Service

ERROR AND ALERT MESSAGES

The Encryption Option has several new error and alert messages. The new messages pertain to encryption procedures and software, but the basic function of the messages remains the same as in the basic 2600 Series Modems. The balance of this chapter describes the error and alert messages that can be displayed in addition to the ones already listed in your *2600 Series Modem User's Manual*.

Error Messages

Error messages are displayed as a result of an operator input or procedural error at the control panel of the modem. See Table 3-2 for encryption-related error messages.

Table 3-3.
Alert Messages

Alert Message	*Parameter*	*Explanation*
ALERT 30	CHG KEY	Each modem pair in a segment must have the same Root Key before you enter this parameter, or communications may be disrupted. Enter CHG KEY to generate a Session Key if none exists or to cause an existing Session Key to be changed. Network operation may be affected according to the mode you have selected for the keyed state. For example, a selection of KYD STBY for the KEYED subcategory will prevent you from transmitting data once the key change takes place.
ALERT 40	ENTR RK	You must enter the same Root Key for each modem in a segment or modem pair before the modems can generate compatible Session Keys, enter the keyed state and begin secure communications.
ALERT 50	ZEROIZE	Entering ZEROIZE erases the current Root Key and Session Key and disrupts all secure communications. Once you have entered this parameter, your modem will be in the unkeyed state, and network operations may be affected according to the mode you have selected for this state. For example, a selection of UKD STBY for the UNKEYED subcategory will prevent you from transmitting data once the keys are zeroized.

Alert Messages

Alert messages are displayed as an intermediate step in the configuration of subcategories when the parameter you enter has a disruptive effect. If you are configuring encryption parameters and an alert message is displayed on the front panel, you may wish to consult Table 3-3 before proceeding.

Chapter 4
Status, Tests, and Diagnostics

Contents

General 4-1
Power-Up Diagnostic Messages 4-2
Test Tree 4-2
Status Tree 4-4
  EC STAT* Category 4-5
  DIAGNOS* Category 4-6
Special Service Requirements 4-8

GENERAL

With the addition of the XL Encryption Option to a standard 2600 Series Modem, the power-up diagnostic, test, and status functions are updated to provide the following additional information:

- ***Power-Up Diagnostic Messages.*** Several messages have been added to describe possible Encryption-related faults during the self-contained power-up diagnostics. As with the basic power-up diagnostic messages, those specific to the EC are supplied primarily to aid trained service personnel in isolating problems.
- ***Test Tree.*** The SeLF RESults category in the Test Tree has a new subcategory that describes whether the EC has passed or failed the SELF* test.
- ***Status Tree.*** The Status Tree has a new category called EC STAT*, and new Diagnostic Codes appear in the DIAGNOS* category.

You should be familiar with the Power-Up Diagnostic Messages and the Test and Status Trees as described in the *2600 Series Modem User's Manual* before attempting to use the revised versions integral to the EC option. The remainder of this chapter contains descriptions of the added functions in these three areas.

POWER-UP DIAGNOSTIC MESSAGES

All power-up diagnostic messages listed in the *2600 Series Modem User's Manual* remain in effect with the Encryption Option. Additional messages appear in Table 4-1.

Table 4-1.
Power-Up Diagnostic Messages

Message	*Definition*
EC__RM__F	Secure or EC RAM failure
EC__PM__F	Secure PROM failure
EC__DEP__F	DEP failure
XL1__PM__F	EC PROM failure
EC__RDY__F	Secure processor not ready
EC__CMD__F	EC command timeout
EC__HALT	EC hardware failure[1]
EC__GONE	EC has been removed
BAD__DTE	DTE software revision level incompatible with EC

---

[1] This diagnostic message can also appear when the OPerating MODE or CONFIRM subcategories are selected from the Status tree. Whenever EC__HALT is displayed on the front panel, an NMS reset or modem power-cycle is required to clear the condition. Call your Codex Customer Service Engineer for assistance if the EC__HALT condition persists after the NMS reset or after you have powered the modem off and on again.

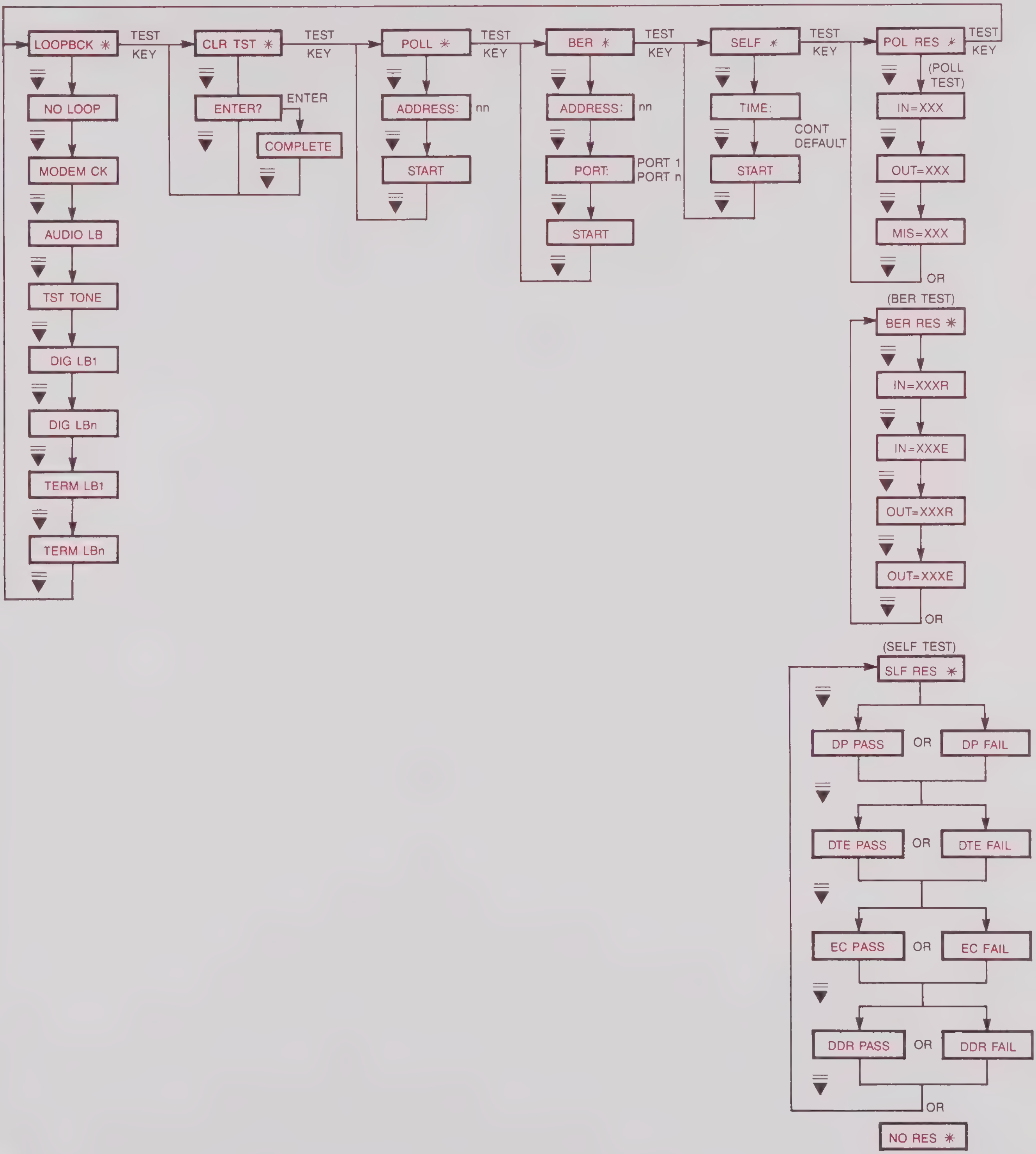
TEST TREE

The Test Tree displayed with the Encryption Option is similar to the version described in the *2600 Series Modem User's Manual*, with one exception. When you run a SELF* test to determine the location of a fault within the modem and view the results of the test under the SLF RES* category, either EC PASS or EC FAIL is displayed in addition to the information concerning the DP, DTE, and other option cards. If EC FAIL appears, your modem will not be able to transmit or receive data. Before taking any other corrective action, power the modem off, make sure the EC is seated properly, and power the modem on again. If the problem persists, call Codex Customer Service.

Although the previous paragraph describes the most obvious addition to the Test Tree with the Encryption Option, you should keep in mind two additional considerations for running tests in the presence of the Encryption Option:

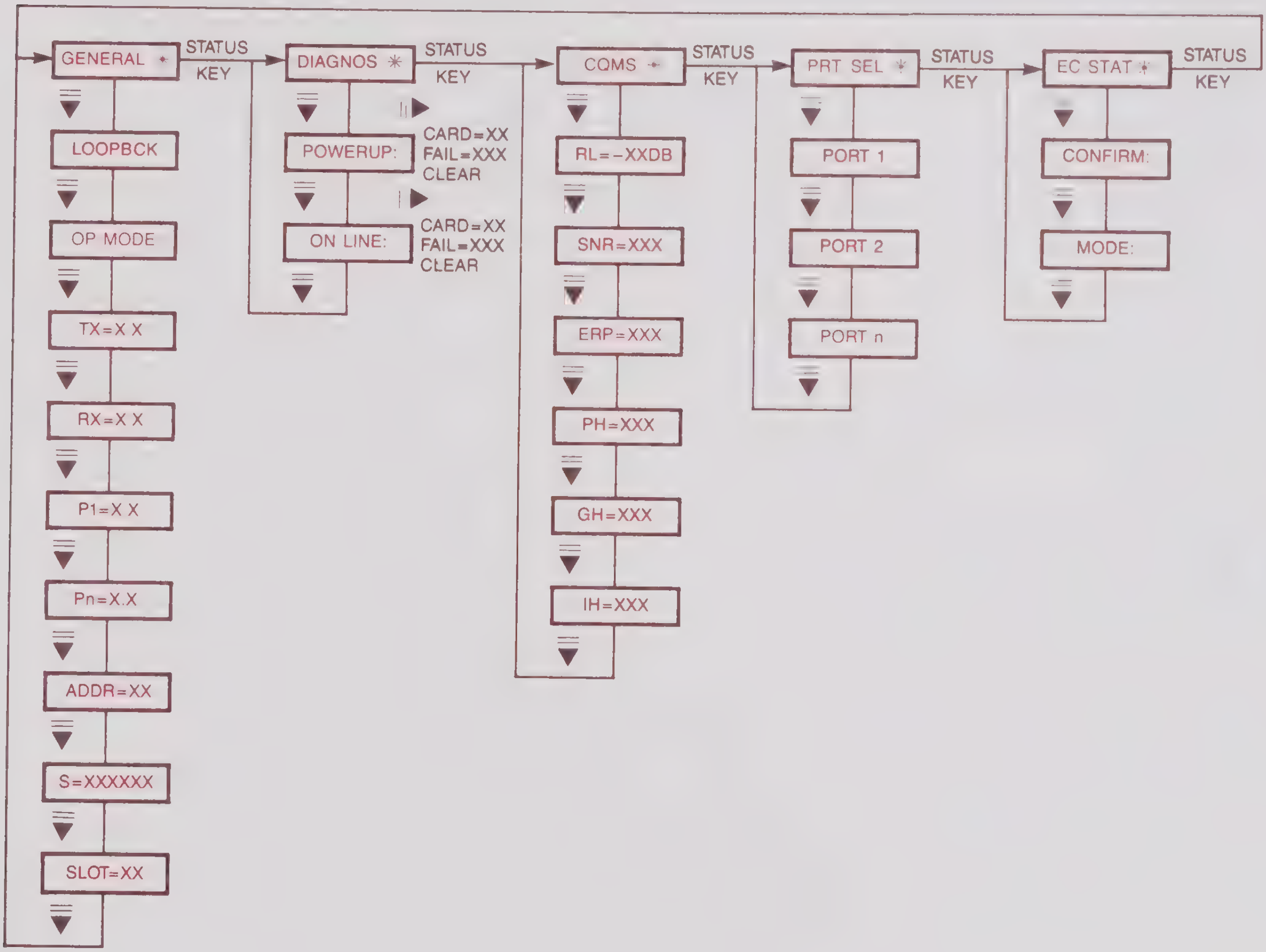
- All Loopback tests are performed with the current key state and encryption mode. For example, if the modem you are initiating tests on is in the KEYED state and SECURE mode, the modem transmits and receives encrypted data during loopback tests.
- Encryption functions are bypassed when BER or Poll tests are initiated, regardless of the current key state or encryption mode. Security is not compromised by these tests, so they are run "in the clear" to aid in fault diagnosis.

See the following example for the location of the new subcategory within the SLF RES* category and Test Tree.


LOOPBCK ✳
TEST KEY
NO LOOP
MODEM CK
AUDIO LB
TST TONE
DIG LB1
DIG LBn
TERM LB1
TERM LBn
CLR TST ✳
TEST KEY
ENTER?
ENTER
COMPLETE
POLL ✳
TEST KEY
ADDRESS:
nn
START
BER ✳
TEST KEY
ADDRESS:
nn
PORT:
PORT 1
PORT n
START
SELF ✳
TEST KEY
TIME:
CONT
DEFAULT
START
POL RES ✳
TEST KEY
(POLL TEST)
IN=XXX
OUT=XXX
MIS=XXX
OR
(BER TEST)
BER RES ✳
IN=XXXR
IN=XXXE
OUT=XXXR
OUT=XXXE
OR
(SELF TEST)
SLF RES ✳
DP PASS
OR
DP FAIL
DTE PASS
OR
DTE FAIL
EC PASS
OR
EC FAIL
DDR PASS
OR
DDR FAIL
OR
NO RES ✳

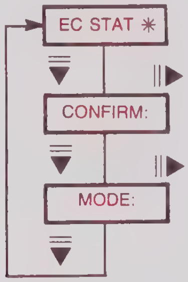
STATUS TREE

Two changes have been made to the Status Tree with the addition of the Encryption Option. A new category titled EC STAT* has been added, and several new diagnostic codes can appear when you use the DIAGNOS* Category. See the following illustration for the revised layout of the Status Tree.


GENERAL *
STATUS KEY
LOOPBCK
OP MODE
TX=X X
RX=X X
P1=X X
Pn=X.X
ADDR=XX
S=XXXXXX
SLOT=XX
DIAGNOS *
STATUS KEY
POWERUP:
CARD=XX
FAIL=XXX
CLEAR
ON LINE:
CARD=XX
FAIL=XXX
CLEAR
COMS *
STATUS KEY
RL=–XXDB
SNR=XXX
ERP=XXX
PH=XXX
GH=XXX
IH=XXX
PRT SEL *
STATUS KEY
PORT 1
PORT 2
PORT n
EC STAT *
STATUS KEY
CONFIRM:
MODE:

EC STAT* Category

This category has been added to the Status Tree to enable you to check encryption functions from the front panel. The EC STAT* Category contains the two subcategories shown below.



CONFIRM. Use this subcategory to confirm that Root Keys or Session Keys are loaded and enabled. One of the following four parameters appears when you use the ||▶ key following the CONFIRM: subcategory.

- *NO RK.* No Root Key has been loaded either with the Modem Loader or with the manual loading method. Secure operation is not possible.
- *UNKNOWN.* A Root Key has been loaded and a Session Key may be present, but it is not known if the local Session Key matches the Session Key of the other modem(s) in the segment. This display appears when a Session Key is not yet available or the modem has been reset (by NMS) or power-cycled with only a Root Key loaded.
- *NUM XXXX.* A Root Key has been loaded and a Session Key is in effect. The numerals shown after the phrase "NUM" represent a portion of the random initialization vector transmitted between modems to synchronize secure communications. When each modem in a segment has the same session number, the Session Keys in effect at each modem are compatible. ■ **Note:** Secure communications cannot take place until the session numbers for all modems in a segment are the same.
- *NO MATCH.* The Root Key has been loaded, but the local Session Key does not match the other Session Keys in the segment. To update the Session Key, initiate another key change (CHG KEY) for the segment from the master encryption modem or via NMS, and then check to make sure the session number of the local modem matches that of the remote modem(s).

MODE. Use this subcategory to verify the current encryption state and the mode currently in effect for that state. When you press the ||▶ key after MODE is displayed, one of the following six parameters appears:

- ***UKD STBY.*** If the UnKeyeD STandBY parameter is displayed, the modem is in the *unkeyed state* and *standby mode*. The modem does not have a Session Key in effect and is unable to transmit data.
- ***UKD BYP.*** The UnKeyeD BYPass parameter is displayed when the modem is in the *unkeyed state* and *bypass mode*. No Session Key is in effect and the modem is able to transmit and receive only clear (unencrypted) text.
- ***SECURE.*** If the SECURE parameter is displayed, the modem is in the *keyed state* and *secure mode*. The modem has a valid Session Key in effect and is able to transmit and receive only encrypted data. ■ **Note:** The session number must be the same for all modems on a segment before the modems can pass encrypted data.
- ***KYD STBY.*** The KeYeD STandBY parameter indicates that the modem is in the *keyed state* and *standby mode*. The modem has a valid Session Key in effect, but is prevented from transmitting user data.
- ***KYD BYP.*** This parameter indicates that the modem is in the *keyed state* and *bypass mode*. The modem has a valid Session Key in effect but will transmit and receive only clear text. If you intend to transmit and receive only encrypted data and this parameter is displayed, consider it a warning that a security breach may occur if you do not change the mode for the keyed state to STANDBY or SECURE.
- ***EC HALT.*** This diagnostic message can also appear during power-up or when the OP MODE subcategory in the Status Tree is selected. The EnCryption HALT parameter indicates that all transmit and receive functions have been halted due to an EC hardware failure. Whenever EC HALT is displayed on the front panel, an NMS reset or modem power-cycle is required to clear the condition. Call your Codex Customer Service Engineer for assistance if the EC HALT condition persists after the NMS reset or after you have powered the modem off and on again.

DIAGNOS* Category

The structure of the DIAGNOS* Category has not changed with the addition of the EC option; however, some new Card Codes and Failure Codes have been added to the existing POWERUP and ON LINE parameters to accommodate the EC option. As with the standard power-up and on-line diagnostic codes, those specific to the EC are displayed primarily to aid trained service personnel in isolating problems. See Table 4-2 for the new Diagnostic Codes.

Table 4-2.
Diagnostic Codes

Card Code	*Failure Code*	*Suspected Area*	*Definition*
Power-Up			
08	001	EC Card	EC PROM failure
08	002	EC Card	EC RAM failure
08	044	EC Card	EC is removed
08	045	EC Card	DTE card not compatible with EC
08	047	EC Card	Secure processor not ready
08	050	EC Card	Secure timer failure
08	051	EC Card	DEP ROM failure
08	052	EC Card	DEP RAM failure
08	053	EC Card	DES maintenance test failure
08	054	EC Card	DEP key address failure
08	055	EC Card	DEP cipher feedback failure
08	056	EC Card	Secure PROM failure
08	058	EC Card	Secure RAM failure
On-Line			
08	040	EC Card	Transmit echo failure
08	041	EC Card	Receive echo failure
08	042	EC Card	Echo test failure during self test
08	043	EC Card	EC command timeout
08	046	EC Card	EC buffer overflow
08	050	EC Card	Secure timer failure
08	051	EC Card	DEP ROM failure
08	052	EC Card	DEP RAM failure
08	053	EC Card	DES maintenance test failure
08	054	EC Card	DEP key address failure
08	055	EC Card	DEP cipher feedback failure
08	056	EC Card	Secure PROM failure
08	057	EC Card	Secure protected RAM failure

SPECIAL SERVICE REQUIREMENTS

If you have performed diagnostic procedures on your Encryption-equipped modem and discovered a problem requiring service, you must make several preparations before scheduling a service call. These special preparations are made necessary by the security features of the Encryption Option and the security precautions in force at your site. When you schedule the service call, plan to have your firm's Security Officer available to meet the Codex Customer Service Engineer (CSE) to provide the CSE with the following:

- Physical access to the malfunctioning modem.
- The modem password, if it has been changed from the default password.[2]
- The password for the ENCRYPT* category in the Configuration Tree.[2]
- The current key state and encryption mode of the modem, for example, unkeyed bypass (UKD BYP).
- If applicable, the Modem Loader used to input Root Keys into the Encryption-equipped modems in your network.

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[2] Your Security Officer can enter this password for the CSE to prevent its disclosure. If the password is disclosed to the CSE, it should be changed by the Security Officer immediately after the service is performed and the CSE has departed.

Glossary

Algorithm	A step-by-step computational procedure.
Clear Text	Also Plain Text. Legible or decrypted text; unencrypted data.
Control Loader	A device that transfers a control program to the Key Programmer and triggers functions such as Copy, Generate, and Erase in the Key Programmer.
Data Encryption Standard (DES)	An encryption algorithm (D.E.A., ANSI X3.92) established by the National Bureau of Standards in 1977 which uses a 64-bit key variable (56 data bits with 8 parity bits). It is based on IBM cryptographic research.
Decrypt	A process of reconstructing the original plain (clear) text from coded cipher text.
Electronic Key Change	The process of changing encryption keys in remote cryptographic devices by electronic or data communications means.
Encrypt	A process of transforming a message into an unintelligible form (coded cipher text) to conceal its meaning.
Encryption	The process of altering information in such a way that it is unintelligible to unauthorized parties.
Encryption Card (EC)	A printed circuit card contained in a 2600 Series Modem that performs encryption/decryption and key management tasks.
Encryption Mode	See Mode.
Independent Encryption Option	A security solution that combines the Encryption Card used in Codex 2600 Series Modems and the 9802 Key Programmer. Can be used with or without a Codex Network Management System.
Key	Also Secret Key. The combination of bits that is used by an algorithm to encrypt data for transmission. In the DES algorithm, the same combination of 64 bits must be used to encrypt data and successfully decrypt the data upon reception.
Key Management	The generation, distribution, control, and destruction of secret keys used in a cryptographic system.
Key Programmer (KP)	A device that generates, copies, and erases secret keys on Modem Loaders (secure key transport devices). The device generates random numbers for keys and excludes all Weak Keys.
Line	One branch of a multi-location data communications network. Usually refers to the entire circuit between a terminal port on a host computer and a particular remote DTE. When tail circuits are used, may refer to a combination of links or segments.
Link	The audio telephone line or circuit connecting two data communications devices. Also see Segment.
Loader	A key transport device that protects the security of encryption keys by preventing anyone from seeing the key. A small plastic key-shaped device designed to transport and load keys electronically into an encryption device. It is programmed initially by the Codex 9802 Key Programmer.

Glossary

Mode	The Encryption Card (EC) processes data in three modes: (1) In Secure mode, the modem transmits and receives encrypted data; (2) In Bypass mode, the modem transmits and receives unencrypted data or clear text; and (3) In Standby mode, the modem does not transmit or receive data.
Modem	A device for performing the necessary signal transformation between terminal devices and communication links. They are used in pairs, one at either end of the communications link.
National Bureau of Standards (NBS)	A division of the Department of Commerce that has direct responsibility for the development of standards for use within the federal government and for compliance with those standards by vendors of equipment to the federal government.
Network	A series of points connected by communication channels. The points may be a mix of data communications equipment such as modems, terminals, or computers. The channels may be telephone lines used for dialed telephone calls or leased lines dedicated to the use of one customer.
Network Management System (NMS)	A software package that allows you to continuously monitor network conditions, isolate network problems, and take restorative action to maintain the flow of communications.
Plain Text	See Clear Text.
Root Key (RK)	The 64-bit key and verification constant used to initialize the key management operation in the Independent Encryption Option. Once initialized, all other keys may be generated and distributed electronically.
Secret Key	See Key.
Segment	The data communications link between two data communications devices (modems). A line may consist of multiple segments.
Session Key	The 64-bit DES key used to encrypt data on a communications link.
Single-Bit Cipher Feedback	The process of removing a bit from an encoded bit stream and using it to transform the clear text or user data coming into an encryption device.
Spoofing	The process by which an adversary taps the communications channel and transmits a known key variable or replays a prior transmission in an attempt to decipher encrypted data.
Variable	An element of an equation that may be changed or varied with each application of the equation.
Verification Constant	A special number used by the Encryption Card in the Independent Encryption Option to verify that Session Key changes resulted in the same new DES key used at each modem on a link.
Weak Key	A symmetrical or easily decoded key. Also see Key.
Zeroize	The destruction or erasure of keys that have been used or are thought to have been compromised, whether stored on a Modem Loader or on an Encryption Card (EC) in a modem.

2600 Series Encryption
User's Guide
Part No. 08512, Rev A
January 1988

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Are the design applications examples helpful?		1	2	3	4	5	
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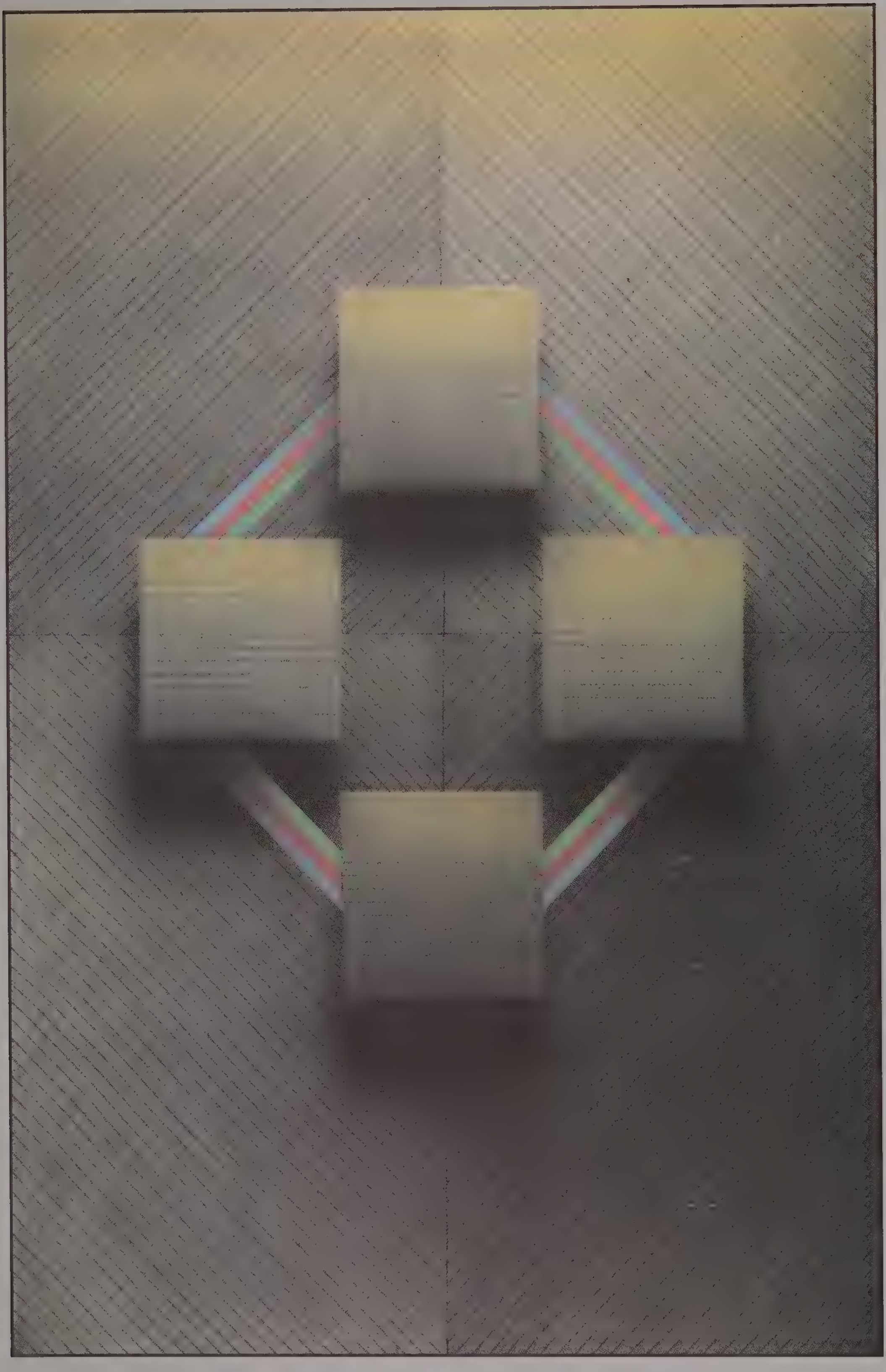

2608 8-Modem Nest User's Guide

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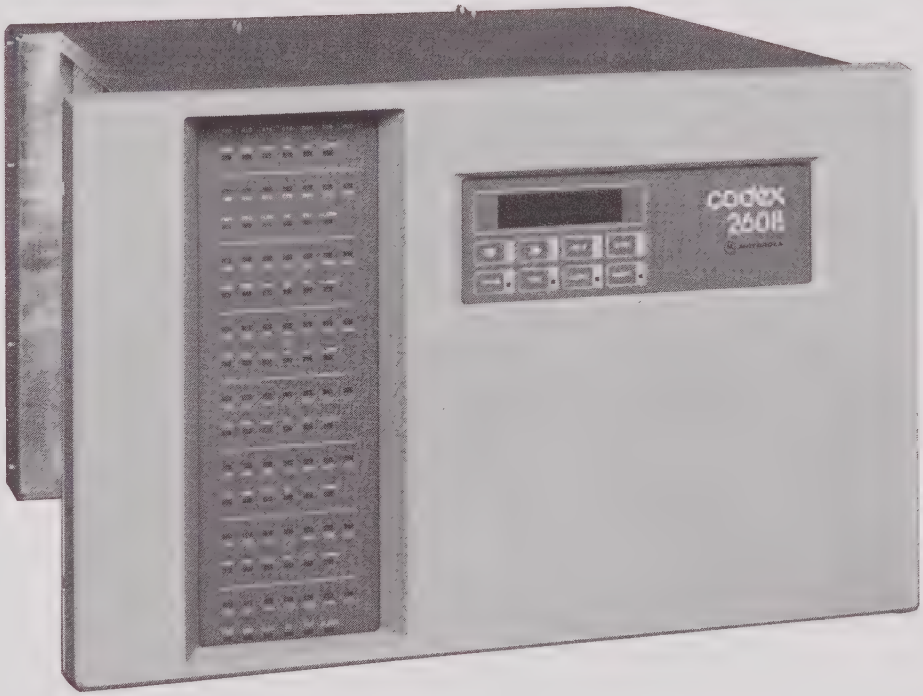
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2608 8-Modem Nest
User's Guide

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User/Reader Comments

A prepaid user questionnaire form is provided in the back of this manual for your comments. Codex welcomes your comments; your input is important in helping us improve the effectiveness of this manual. Thank you.

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

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Contents

Preface iv

Chapter 1. Introduction

2608 Overview 1-1
Modem Numbering in the 8-Modem Nest .. 1-2
Modem Configuration 1-3
Main Differences between the 2608 and
  2600 Series Modems 1-3
  Control Panel 1-3
  DTE Input/Output 1-3
  Leased Line Audio Input/Output 1-3
  Power Supply 1-4

Chapter 2. Control Panel

Control Panel Trees 2-1
Sending and Receiving User Messages 2-3
2608 Error Messages 2-3

Chapter 3. Installation, Maintenance, and Specifications

Installation Procedures 3-1
  Installation with Mechanical Lifting
    Equipment 3-2
  Installation without Mechanical Lifting
    Equipment 3-2
  Rear Mounting Brackets 3-2
Maintenance Procedures 3-2
  Replacing Modem Cards 3-2
  Replacing Power Supplies 3-5
  Replacing Fans 3-5
Specifications 3-5
  Dimensions and Weight 3-5
  Primary Power Requirement 3-5
  Line Fuse Rating 3-5
  Audio I/O Interface 3-5
Product Codes 3-6
  Enclosure 3-6
  Data Pump Cards 3-6
  DTE Cards 3-6
  Power Supply 3-6
  Cables 3-6

Preface

The Codex 2608 8-Modem Nest is a member of the 2600 Series family of high-speed modems. Many of its features, functions, and operating procedures are identical to those of the 2600. Therefore, you should read the Codex *2600 Series Modem User's Manual* to gain familiarity with the product, for data communications explanations, and for associated operating and troubleshooting procedures. This document supplements the *2600 User's Manual,* providing information that pertains to the 8-Modem Nest only.

Chapter 1, Introduction, begins with an overview of the 2608 and explains the major differences between the 8-Modem Nest and the 2600 Series standalone models.

Chapter 2, Control Panel, explains how to use the 2608 Control Panel, lists the 2608 Control Panel error messages, and describes the NEST* category of the REMOTE Tree, which is added to the 2600 Control Panel Trees with the purchase of the 8-Modem Nest.

Finally, Chapter 3, Installation, Maintenance, and Specifications, explains how to install the unit and provides information on replacing the 8-Modem Nest subassemblies. The chapter includes specifications and product codes.

Chapter 1
Introduction

Contents

2608 Overview 1-1
Modem Numbering in the 8-Modem Nest .. 1-2
Modem Configuration 1-3
Main Differences between the 2608 and
  2600 Series Modems 1-3
  Control Panel 1-3
  DTE Input/Output 1-3
  Leased Line Audio Input/Output 1-3
  Power Supply 1-4

2608 OVERVIEW

The 2608 8-Modem Nest consists of a single enclosure that may contain as many as eight 2600 Series Modems, four power supplies (one for each of two modems), a fan assembly with three removable fans and a Control Panel that is common to all modems in the nest.

The 2608 allows you to mix and match 2620, 2640, and 2660 modems and 4- or 6-channel multiplexer options with both point-to-point and multipoint applications. Both the four- and six-channel options include the built-in Modem Sharing Unit (MSU), async/sync converter and control signaling capability. Once you have installed a minimum of one modem and one power supply, you can add additional modem card sets and power supplies, which you may purchase separately from the factory. You can easily incorporate these components into the nest and configure them from the 2608 Control Panel or a Codex DNCS central site controller.

Each modem is made up of a Data Pump card and a 1, 4, or 6-channel DTE card. All nested modems are compatible with Codex Network Management Systems standard. With the exception of the Dual Dial Restoral (DDR) and XL-1 options, all 2600 Series

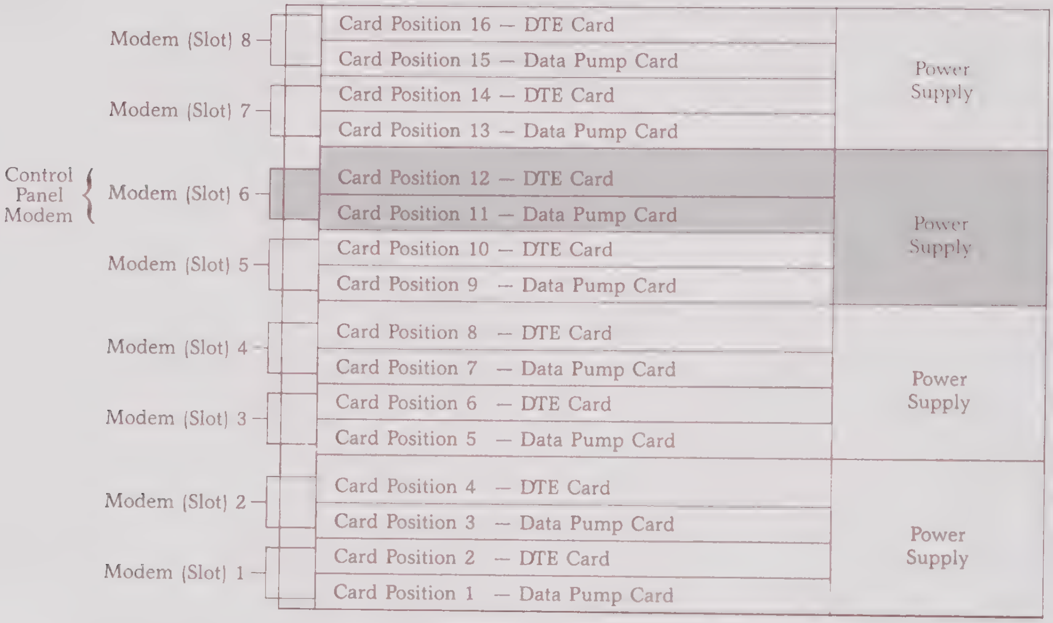

Modem (Slot) 8
Modem (Slot) 7
Control Panel Modem
Modem (Slot) 6
Modem (Slot) 5
Modem (Slot) 4
Modem (Slot) 3
Modem (Slot) 2
Modem (Slot) 1
Card Position 16 — DTE Card
Card Position 15 — Data Pump Card
Card Position 14 — DTE Card
Card Position 13 — Data Pump Card
Card Position 12 — DTE Card
Card Position 11 — Data Pump Card
Card Position 10 — DTE Card
Card Position 9 — Data Pump Card
Card Position 8 — DTE Card
Card Position 7 — Data Pump Card
Card Position 6 — DTE Card
Card Position 5 — Data Pump Card
Card Position 4 — DTE Card
Card Position 3 — Data Pump Card
Card Position 2 — DTE Card
Card Position 1 — Data Pump Card
Power Supply
Power Supply
Power Supply
Power Supply

Figure 1-1. 2608 8-Modem Nest Card Configuration

features and operating modes are available for each modem in the 2608 8-Modem Nest, including Trellis Coded Modulation (TCM), Adaptive Rate System (ARS), Mixed Inbound Rate (MIR), Codex Improved 96 (CI96) and Train On Data (TOD).

MODEM NUMBERING IN THE 8-MODEM NEST

The 2608 may contain as few as one or as many as eight modems, which are identified by their positions in the nest. Figure 1-1 illustrates card configuration for the 8-Modem Nest. ■ **Note:** On the Control Panel, the modem number is also referred to as slot number. The two terms are used interchangeably.

Modem numbers (slot numbers) are assigned from the bottom of the nest to the top according to the positions of the Data Pump and DTE cards. Modem 1 always consists of the Data Pump and DTE cards that occupy card positions 1 and 2; Modem 2 is always represented by the Data Pump and DTE cards located in positions 3 and 4; and so on up through the nest.

As with the 2600 Series modems, each 2608 product has a unique serial number; however, only one serial number is defined for the entire 8-Modem Nest unit.

When the nest is powered up, the serial number is transferred from the backplane of the unit to Modem 6 (slot number 6), and then on to the other modems in the nest. In order for the serial number power-up transfer feature to function properly, card positions 11 and 12 (Modem 6) must be occupied. Once the unit is powered up and the serial number transfer has taken place, you may remove Modem 6 without affecting operation of the other modems in the nest; however, without Modem 6, there is no Control Panel access to the other modems. ■ **Note:** The Control Panel is always physically connected to the Data Pump card of Modem 6 (card position 11). If your nest contains fewer than eight modems, slot number 6 must be filled first.

Refer to Chapter 2 for an explanation of how slot numbers (modem numbers) are used for modem selection from the Control Panel, and how serial numbers and slot numbers are used together to assign network control addresses for your system.

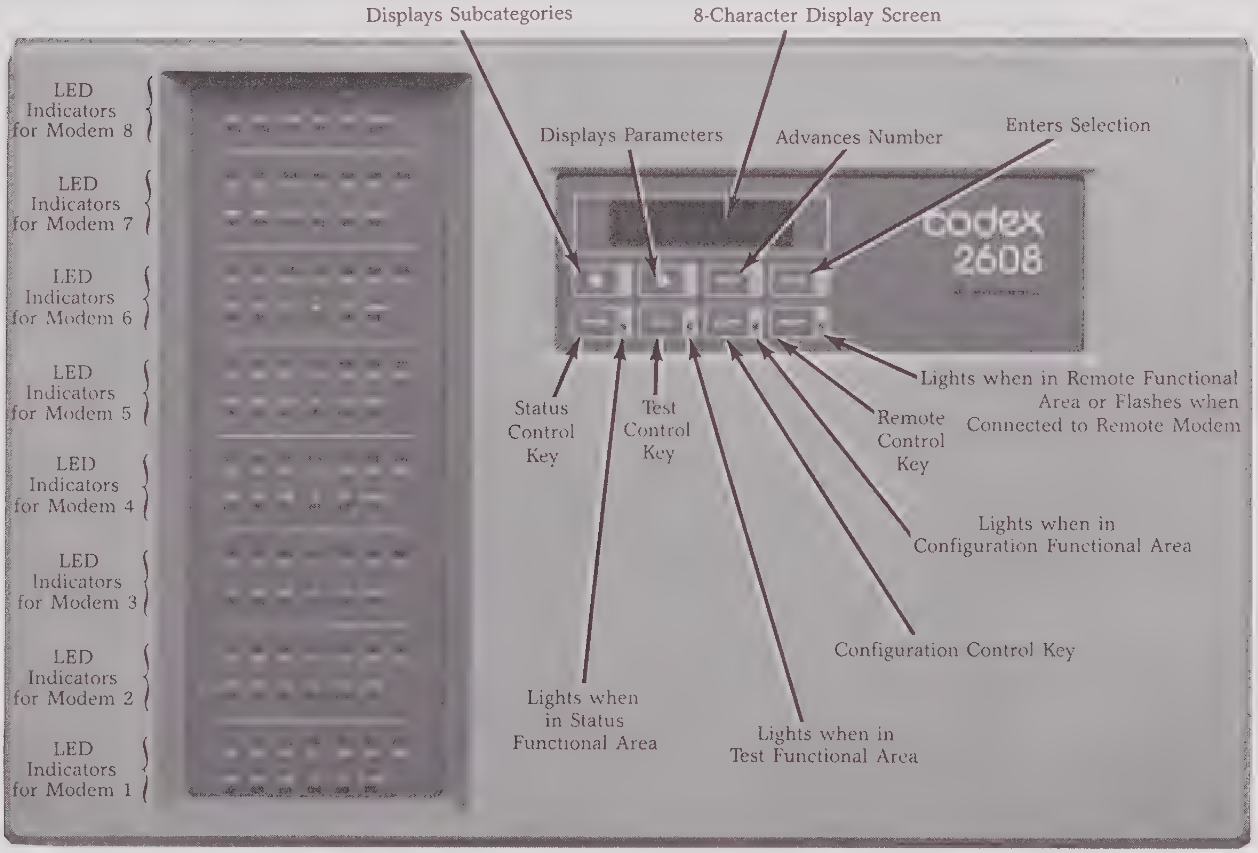

Displays Subcategories
8-Character Display Screen
LED Indicators for Modem 8
LED Indicators for Modem 7
LED Indicators for Modem 6
LED Indicators for Modem 5
LED Indicators for Modem 4
LED Indicators for Modem 3
LED Indicators for Modem 2
LED Indicators for Modem 1
Displays Parameters
Advances Number
Enters Selection
codex 2608
Lights when in Remote Functional Area or Flashes when Connected to Remote Modem
Status Control Key
Test Control Key
Remote Control Key
Lights when in Configuration Functional Area
Configuration Control Key
Lights when in Status Functional Area
Lights when in Test Functional Area

Figure 1-2. 2608 8-Modem Nest Control Panel

MODEM CONFIGURATION

Refer to Chapter 4 of the *2600 Series User's Manual* for information on how to choose the proper modem configuration settings for your particular applications. A white label located inside the Control Panel door provides a quick reference to the configuration of modems within the nest. Whenever you install additional modems in the nest, you should record their slot assignments on this label.

MAIN DIFFERENCES BETWEEN THE 2608 AND 2600 SERIES MODEMS

The 2608 differs from the 2600 Series Modems in four areas: the Control Panel, DTE Input/Output, Audio Input/Output, and Power Supply.

Control Panel

The 2608 Control Panel resembles the 2600 Series Control Panel in functionality and appearance. It consists of 8 control keys, an 8-character alphanumeric display, and 13 LED indicators for each modem in the nest (see Figure 1-2).

DTE Input/Output

DTE input/output connections for the 2608 consist of six EIA RS-232-C compatible ports per modem. Each modem is also equipped with a network control port for DNCS applications. See Figure 1-3 for the DTE I/O connector assignments and functions.

Leased Line Audio Input/Output

The 2608 leased line audio connection consists of a 50-wire cable fitted with a 50-pin connector that connects to the rear panel of the 8-Modem Nest. This

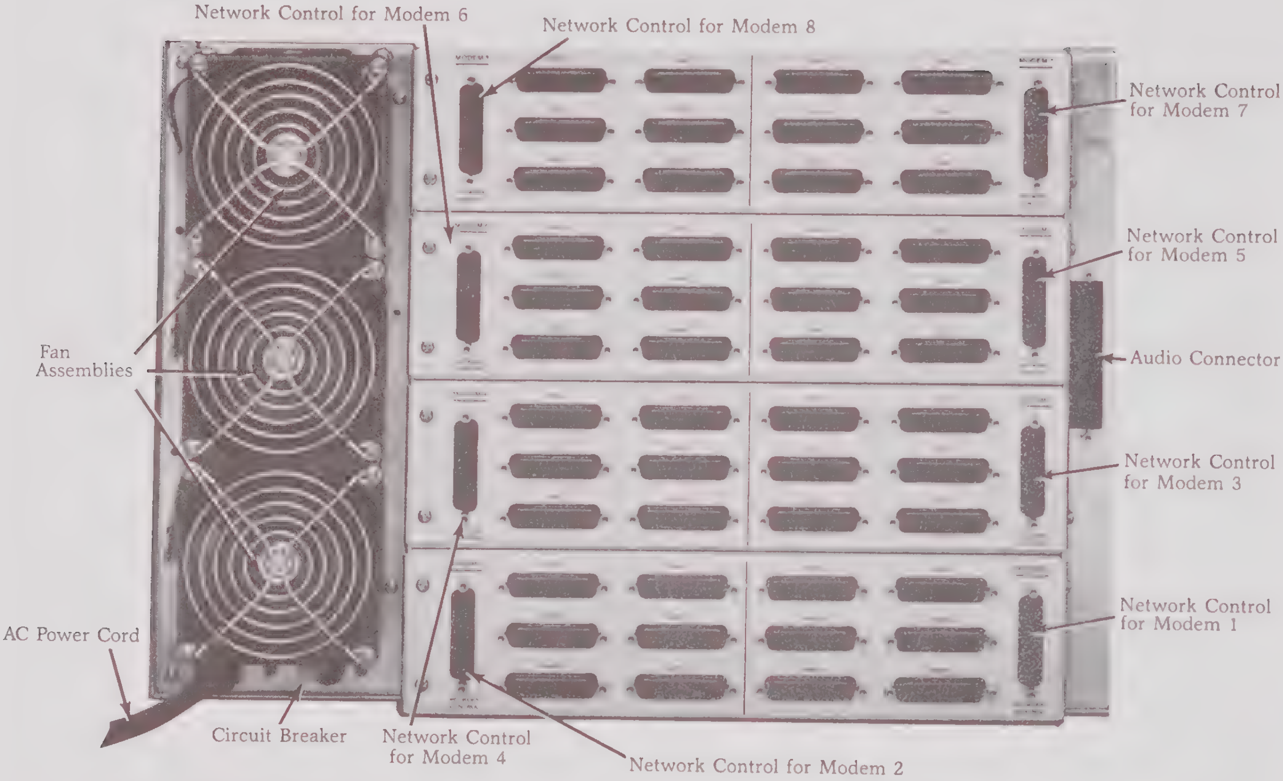

Network Control for Modem 6
Network Control for Modem 8
Network Control for Modem 7
Network Control for Modem 5
Audio Connector
Fan Assemblies
Network Control for Modem 3
Network Control for Modem 1
AC Power Cord
Circuit Breaker
Network Control for Modem 4
Network Control for Modem 2

Figure 1-3. 2608 8-Modem Nest Rear Panel

single, FCC-approved connection provides the 32 active audio signals (transmit and receive pairs) that are necessary for the operation of a fully loaded nest.

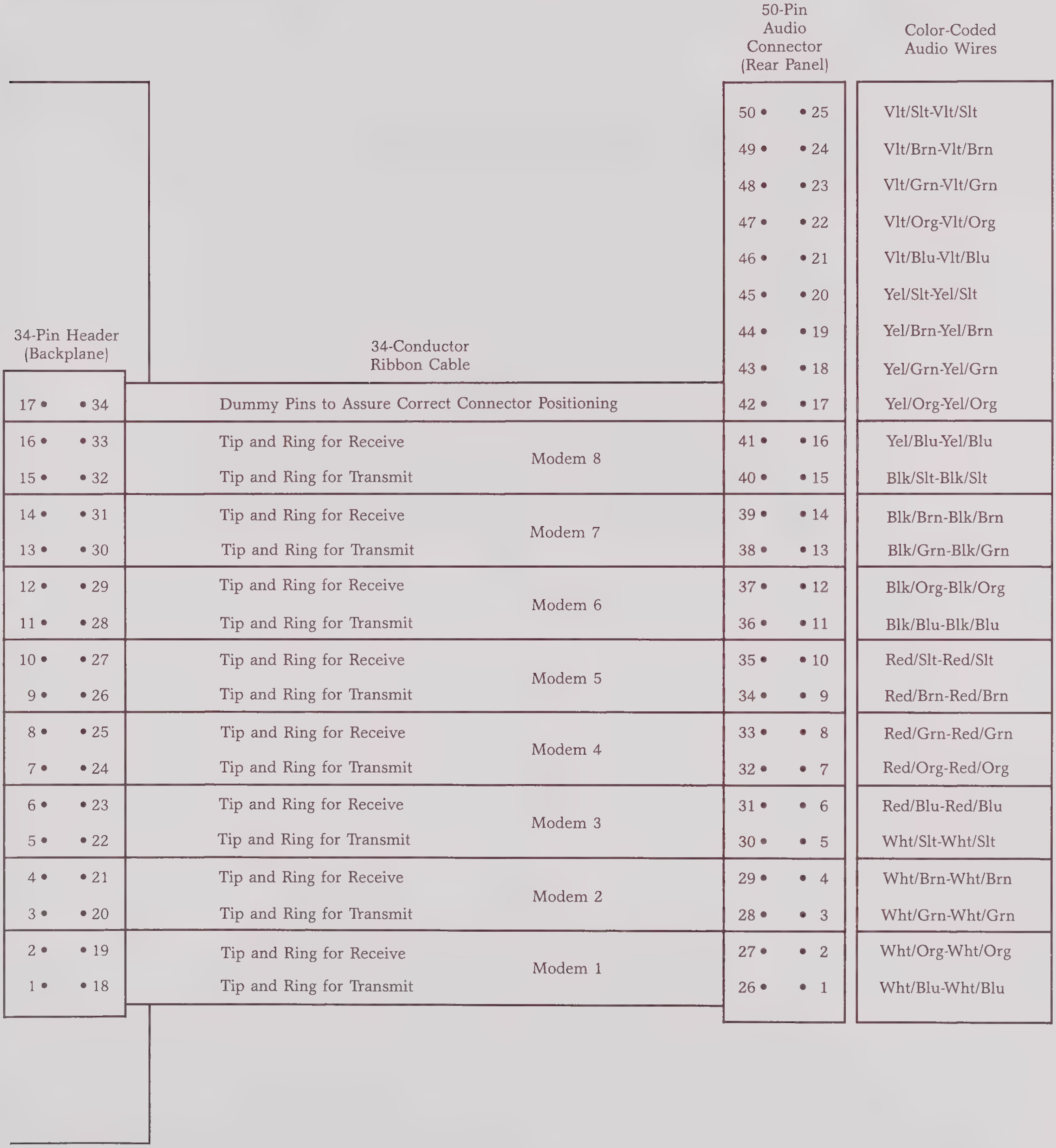
The stub end of the audio cable reveals the 50 color-coded wires that will be terminated when the nest is installed. See Figure 1-3 for the location of the audio I/O connector on the rear panel of the nest, and refer to Figure 1-4 for important information on individual pin assignments and the corresponding colored wires.

Power Supply

The 2608 8-Modem Nest requires four power supplies, or one for each of two adjacent modems in the nest. Power supplies are located behind the Control Panel to the right of the modem cards and are accessed from the front of the unit (see Figure 1-5). A 6-ft (182.88 cm) power cord provides the ac power connection to the nest, and a circuit breaker is located at the back of the unit (see Figure 1-3).

The power supplies are not equipped with external On/Off switches. Rather, an interlock switch located behind each power supply next to the power supply card connector closes when the supply is properly seated in the nest. Successful closure of this switch transfers power to the two modems in that part of the nest, and the appropriate power indicators on the Control Panel light up.

If the power LEDs fail to light when power is applied to the nest, reseat the power supply card before assuming that the entire supply is faulty. See Chapter 3 for more information on how to reseat or replace a power supply.



34-Pin Header (Backplane)		34-Conductor Ribbon Cable		50-Pin Audio Connector (Rear Panel)		Color-Coded Audio Wires
				50	25	Vlt/Slt-Vlt/Slt
				49	24	Vlt/Brn-Vlt/Brn
				48	23	Vlt/Grn-Vlt/Grn
				47	22	Vlt/Org-Vlt/Org
				46	21	Vlt/Blu-Vlt/Blu
				45	20	Yel/Slt-Yel/Slt
				44	19	Yel/Brn-Yel/Brn
				43	18	Yel/Grn-Yel/Grn
17	34	Dummy Pins to Assure Correct Connector Positioning		42	17	Yel/Org-Yel/Org
16	33	Tip and Ring for Receive	Modem 8	41	16	Yel/Blu-Yel/Blu
15	32	Tip and Ring for Transmit		40	15	Blk/Slt-Blk/Slt
14	31	Tip and Ring for Receive	Modem 7	39	14	Blk/Brn-Blk/Brn
13	30	Tip and Ring for Transmit		38	13	Blk/Grn-Blk/Grn
12	29	Tip and Ring for Receive	Modem 6	37	12	Blk/Org-Blk/Org
11	28	Tip and Ring for Transmit		36	11	Blk/Blu-Blk/Blu
10	27	Tip and Ring for Receive	Modem 5	35	10	Red/Slt-Red/Slt
9	26	Tip and Ring for Transmit		34	9	Red/Brn-Red/Brn
8	25	Tip and Ring for Receive	Modem 4	33	8	Red/Grn-Red/Grn
7	24	Tip and Ring for Transmit		32	7	Red/Org-Red/Org
6	23	Tip and Ring for Receive	Modem 3	31	6	Red/Blu-Red/Blu
5	22	Tip and Ring for Transmit		30	5	Wht/Slt-Wht/Slt
4	21	Tip and Ring for Receive	Modem 2	29	4	Wht/Brn-Wht/Brn
3	20	Tip and Ring for Transmit		28	3	Wht/Grn-Wht/Grn
2	19	Tip and Ring for Receive	Modem 1	27	2	Wht/Org-Wht/Org
1	18	Tip and Ring for Transmit		26	1	Wht/Blu-Wht/Blu

Figure 1-4. 2608 8-Modem Nest Audio Interface

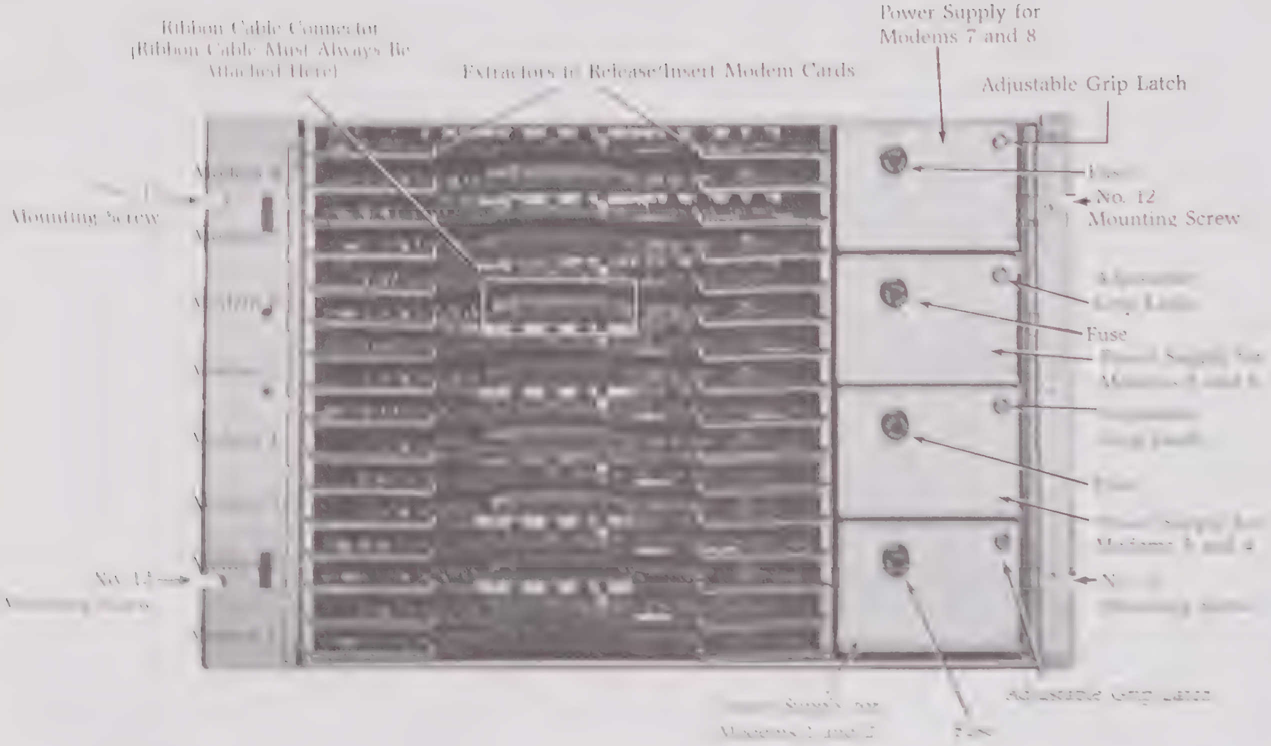

Ribbon Cable Connector
(Ribbon Cable Must Always Be
Attached Here)
Extractors to Release/Insert Modem Cards
Power Supply for
Modems 7 and 8
Adjustable Grip Latch
Modem 8
No. 12
Mounting Screw
Modem 7
Modem 6
Modem 5
Modem 4
Modem 3
Modem 2
Modem 1
Fuse
No. 12
Mounting Screw
Adjustable
Grip Latch
Fuse
Power Supply for
Modems 5 and 6
Adjustable
Grip Latch
Fuse
Power Supply for
Modems 3 and 4
No. 12
Mounting Screw
Power Supply for
Modems 1 and 2
Fuse
Adjustable Grip Latch

Figure 1-5. 2608 8 Modem Nest with Control Panel Door Opened

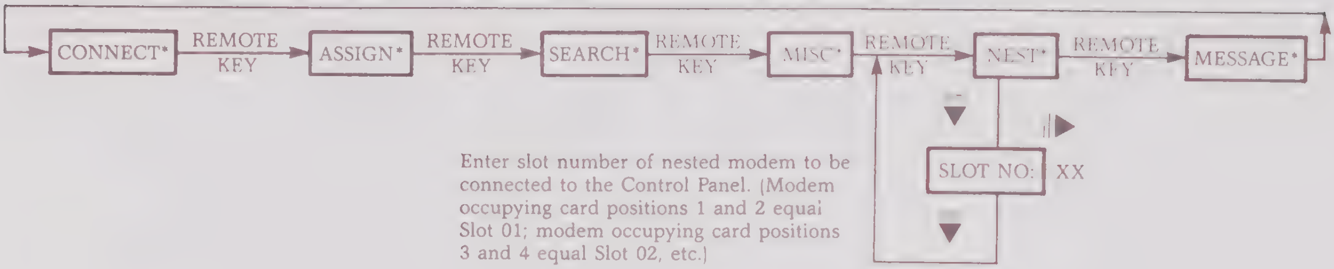
Chapter 2
Control Panel

Contents

Control Panel Trees 2-1
Sending and Receiving User Messages 2-3
2608 Error Messages 2-3

CONTROL PANEL TREES

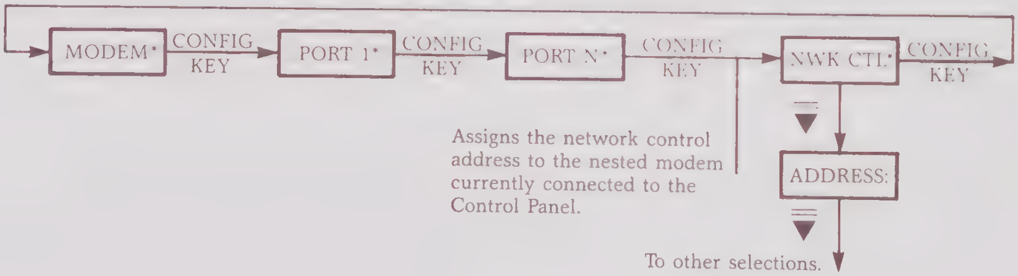
The Control Panel Trees for the 2608 8-Modem Nest are identical to those of the 2600 standalone models, with one exception: a new category, NEST*, has been added to the Remote Tree, which allows you to transfer the Control Panel connection to any modem in the nest.


CONNECT*
REMOTE KEY
ASSIGN*
REMOTE KEY
SEARCH*
REMOTE KEY
MISC*
REMOTE KEY
NEST*
REMOTE KEY
MESSAGE*
SLOT NO:
XX

Enter slot number of nested modem to be connected to the Control Panel. (Modem occupying card positions 1 and 2 equal Slot 01; modem occupying card positions 3 and 4 equal Slot 02, etc.)

To connect to another modem in the nest, enter the NEST* category of the Remote Tree. Respond to the request for SLOT NO: by entering the 2-digit slot number of the modem you wish to access, then press the ENTER key. The display will respond with the selected slot number (modem number). ■ **Note:** If you leave the NEST* category after you enter the desired slot number and then later come back, the SLOT NO: subcategory will not display the same number. Instead it will display the next slot number in sequence. The currently selected slot number (modem number) will only be displayed in the GENERAL* category of the Status Tree.

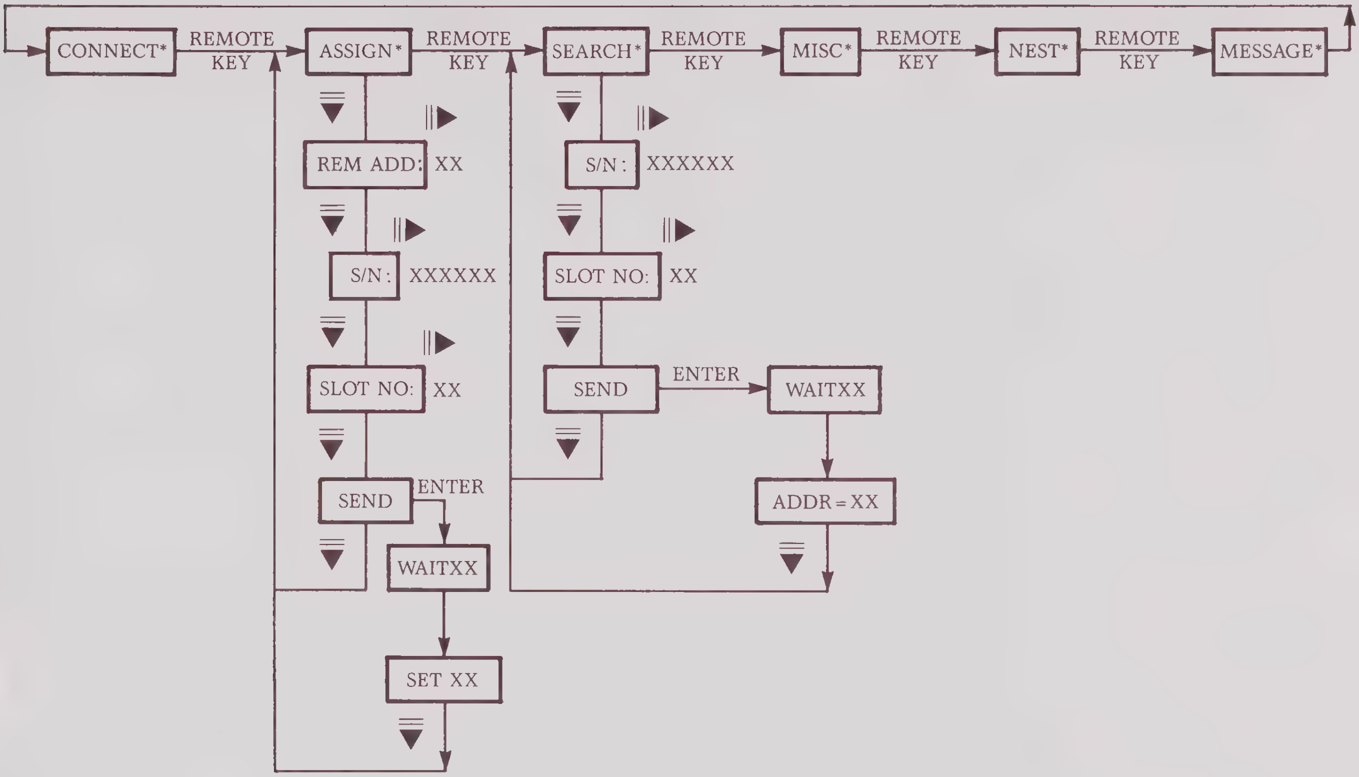
To assign a network control address to a modem in the local nest, connect to the desired modem via the NEST* category of the Remote Tree; then assign the network control address through the NWK CTL* category of the Configuration Tree.


MODEM*
CONFIG KEY
PORT 1*
CONFIG KEY
PORT N*
CONFIG KEY
NWK CTL*
CONFIG KEY
ADDRESS:

Assigns the network control address to the nested modem currently connected to the Control Panel.

To other selections.

Assign or search for the network control addresses of nested modems at remote locations in the same way you deal with such addresses for 2600 Series modems: through the ASSIGN* and SEARCH* categories of the Remote Tree. The only difference is that you must also supply the appropriate slot number (modem number).


CONNECT*
REMOTE KEY
ASSIGN*
REMOTE KEY
SEARCH*
REMOTE KEY
MISC*
REMOTE KEY
NEST*
REMOTE KEY
MESSAGE*
REM ADD: XX
S/N: XXXXXX
SLOT NO: XX
SEND
ENTER
WAITXX
SET XX
S/N: XXXXXX
SLOT NO: XX
SEND
ENTER
WAITXX
ADDR = XX

SENDING AND RECEIVING USER MESSAGES

As with the 2600 Series Modems, the 2608 allows you to send a 2-digit user message to remote modems through the MESSAGE* category of the Remote Tree.

When a message is received by a nested modem that is not currently connected to the Control Panel, it is stored in memory until the next time that modem and the Control Panel are connected. Once the connection is made, the stored message is the first item displayed on the Control Panel.

2608 ERROR MESSAGES

The 2608 software contains most of the error messages of the 2600 Series Modems with the addition of ERROR 25 (see Table 2-1). Note that when there is a failure in the communications channel between modems, the Control Panel automatically connects to Modem 6 (slot number 6), even if it was connected to another modem when the error occurred.

At power-up, any error messages displayed on the Control Panel apply only to Modem 6. You may detect a failure condition in the other nested modems in the following ways:

- If an ALARM indicator is On, select the appropriate modem via the Control Panel and enter the DIAGNOS* category of the STATUS functional area to determine the nature of the failure (see Chapter 4 of the *2600 User's Manual* for the DIAGNOS* functions).
- If you are unable to connect to the appropriate modem, try again. If still unsuccessful, power down and move the DTE and Data Pump cards of that modem to slot number 6 (card positions 11 and 12). This process will give you direct access to the Control Panel failure message displays. ■ **Note:** Read Replacing Modem Cards and Replacing Power Supplies, Chapter 3, before moving any modem cards.

Table 2-1.
2608 8-Modem Nest Control Panel Error Messages

Error Message	*Definition*	*Recommended Action*
These messages represent operator input errors and communication line faults and do not reflect a failure within the modem.		
ERROR 20	No response received from remote modem.	Verify network control address. If correct, run diagnostic tests to check communication line to remote modem.
ERROR 25	No response received from nest modem. Now connected to Modem 6.	Reseat modem cards, reconnect to desired modem, and try again.
ERROR 30	Remote response has an invalid checksum.	You most likely have a problem with your communications line. Check configuration (such as FSK rate compatibility), and run diagnostics on communications line to remote modem.
ERROR 40	Invalid response received or remote modem is in Override.	Check that remote modem is not in Override (see MISC* Category paragraph in Chapter 4 of the *User's Manual)* and that compatibility exists between local and remote modems. Try again.
ERROR 50	Already on dial line.	No action necessary.
ERROR 52	Already on leased line.	No action necessary.
ERROR 54	No response received from remote modem.	Wait three minutes for remote modem to switch to dial line.
ERROR 56	No response received from remote modem.	Check to see if passing data on dial line. If not, terminate using 'W/O TST'
ERROR 60	Operation not currently allowed because modem is controlled by a remote source (network control or a remote modem).	Check with network control for permission to enter manual Override (see MISC* Category paragraph in Chapter 4 of the *User's Manual).*
ERROR 70	Illegal assignment of ports to channels.	Enter proper port-to-channel configuration (see Chapter 4 of the *User's Manual).*
ERROR 80	Undefined configuration memory data or not valid to configure this parameter in this application.	Scroll to proper selection and press ENTER to correct configuration data (see appropriate category in Chapter 4 of the *User's Manual).*
ERROR 85	Audio Loopback Test disabled.	Do not use audio loopback or enable audio loopback (see Chapter 4 of the *User's Manual).*
ERROR 90	Illegal password.	Retry password entry (see Numerical Data Entry paragraph in Chapter 4 of the *User's Manual).*

Chapter 3
Installation, Maintenance, and Specifications

Contents

Installation Procedures 3-1
  Installation with Mechanical Lifting Equipment 3-2
  Installation without Mechanical Lifting Equipment 3-2
  Rear Bracket Mounting 3-2
Maintenance Procedures 3-2
  Replacing Modem Cards 3-2
  Replacing Power Supplies 3-5
  Replacing Fans 3-5
Specifications 3-5
  Dimensions and Weight 3-5
  Primary Power Requirement 3-5
  Line Fuse Rating 3-5
  Audio I/O Interface 3-5
Product Codes 3-6
  Enclosure 3-6
  Data Pump Cards 3-6
  DTE Cards 3-6
  Power Supply 3-6
  Cables 3-6

INSTALLATION PROCEDURES

The 2608 8-Modem Nest is designed to be bolted directly to a standard 19 in. (48.26 cm) wide rack. Five 8-Modem Nests may be mounted in a single 72 in. (182.88 cm) high rack. Please refer to Chapter 5 of the *2600 Series User's Manual* for pertinent information on site selection and preparation requirements for installing a rack-mount.

> *WARNING*
> A fully loaded 8-Modem Nest weighs 92 lbs (41.40 kg). Use care during the entire installation process.

You can install the 8-Modem Nest with or without the aid of mechanical lifting equipment. ■ **Note:** When installing your nest, first attach the rear mounting brackets to the left and right rear of the unit, using No. 6-32 screws. Then follow one of the procedures described below.

Installation with Mechanical Lifting Equipment

Once the nest is lifted to the desired height, make sure the mounting angles on the front of the nest are flush with the front of the rack (shown in Figure 1-5 in Chapter 1); then secure in place with eight, No. 12 panhead screws and clip-on speed nuts.

> *WARNING*
> Be sure to place screws in all eight locations and double-check to make sure they are tight. These eight screws support the weight of the entire nest.

Installation without Mechanical Lifting Equipment

If lifting equipment is not available, you may reduce the weight of the nest by removing the modem cards and power supplies before attempting to mount it to the rack. If you choose this method, be sure to follow instructions for replacing modem cards and power supplies (next section of this chapter) when emptying and reassembling the nest.

With help from at least one other person lift the empty nest and slide it into the rack, making sure that the mounting angles on the front of the nest are flush with the front of the rack (see Figure 1-5 in Chapter 1); then secure in place with eight, No. 12 panhead screws and clip-on speed nuts. See Warning above.

Rear Bracket Mounting

Once the unit is in place on the rack with the front brackets mounted, go to the back of the unit and proceed with the following steps:

1) Mount the two rear adjustment brackets to the two rear mounting brackets using No. 10-32 x .50 panhead screws, No. 10 washers, and internal tooth washers for each bracket (see Figure 3-1). ■ **Note:** Depending on the location of the rear mounting rail, the brackets may need to be rotated 180°, as shown, for a secure attachment.

2) Fasten the rear mounting brackets to the rack, using 12-24 x .50 screws and clip-on speed nuts (see Figure 3-1).

Replace the modem cards and power supplies using procedures in the next section of this chapter. Then configure nested modems by following instructions in Chapter 4 of the *2600 Series User's Manual.*

MAINTENANCE PROCEDURES

Maintenance procedures for the 8-Modem Nest are identical to those outlined in the *2600 Series User's Manual* except when replacing PC cards, Power Supplies, or fan assemblies.

Modem cards and power supplies are accessed from the front of the nest. When replacing a modem card or power supply, first remove the dress panel from the nest by pulling it straight off the front of the unit. Next, loosen the captive panel screw on the left side of the Control Panel door and swing it open to the right.

Replacing Modem Cards

The 2608 allows you to insert or remove modems from the nest with the power on. Operation of the other modems in the nest is not affected.

Modem configuration data is stored in nonvolatile (E^2) memory on the DTE card, allowing the modem to save configuration information when power is lost. A strap (J40), located at the front of the DTE card, allows you to enable or disable this nonvolatile memory (see Figure 3-2).

Before removing a DTE card, move J40 to the DISABLE position, connecting the two rightmost pins, as shown in Figure 3-2. Moving J40 to DISABLE will prevent the loss of your configuration data when the card is removed.
■ **CAUTION:** *You may need a screwdriver to lift the E^2 strap. If so, slip the tip of the screwdriver under the strap and use it as a wedge to gently lift the strap to remove it from the two pins. Be careful not to damage the PC card.*

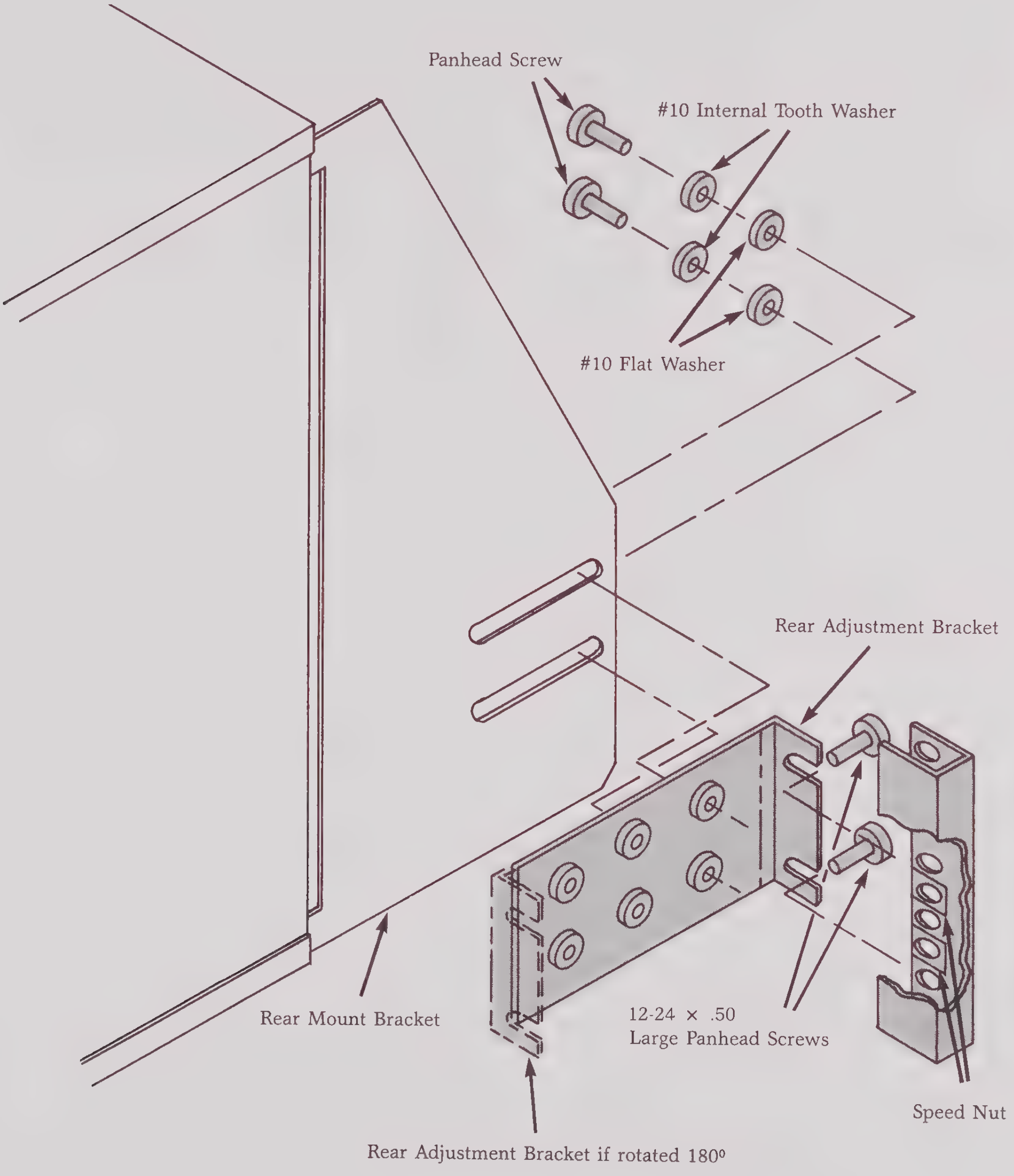
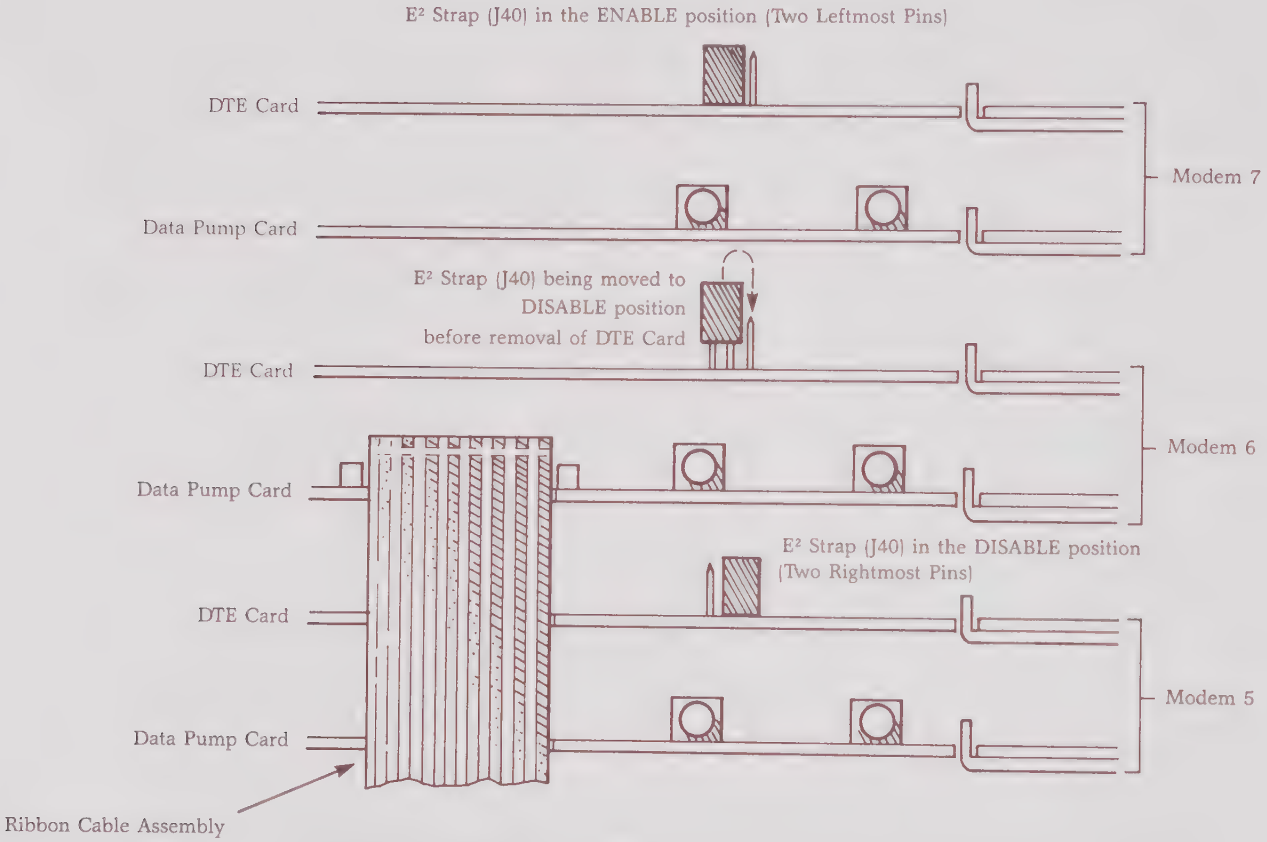

Panhead Screw
#10 Internal Tooth Washer
#10 Flat Washer
Rear Adjustment Bracket
Rear Mount Bracket
12-24 × .50
Large Panhead Screws
Speed Nut
Rear Adjustment Bracket if rotated 180°

Figure 3-1. Rear Bracket Subassembly


E^2 Strap (J40) in the ENABLE position (Two Leftmost Pins)
DTE Card
Data Pump Card
Modem 7
E^2 Strap (J40) being moved to DISABLE position before removal of DTE Card
DTE Card
Data Pump Card
Modem 6
E^2 Strap (J40) in the DISABLE position (Two Rightmost Pins)
DTE Card
Data Pump Card
Modem 5
Ribbon Cable Assembly

■**NOTE:** Always move the E^2 Strap (J40) to the DISABLE position before removing a DTE Card.

Figure 3-2. DTE Card Nonvolatile (E^2) Memory Strap (J40)

To remove a DTE or Data Pump card, follow the procedure outlined below.

1) First, pull the two metal extractors on the front of the card towards you to release it. Then slide the card out of the nest (extractors are shown in Figure 1-5 in Chapter 1).

2) Reinsert a card in the same way, using the extractors to push the card into place on the backplane. The extractors should be aligned with the bottom of the PC card, indicating the card is fully inserted. After reinserting a DTE card, move J40 back to the ENABLE position, connecting the two leftmost pins.

3) Observe that the ribbon cable is attached to the Data Pump card of Modem 6 (refer to Figure 1-5 in Chapter 1). Before removing the Data Pump card of Modem 6, remove the ribbon cable by releasing the card with the extractors, then unsnapping the sides of the ribbon cable connector. When replacing the Data Pump card, be sure to seat the ribbon cable in the connector and snap in place.

Replacing Power Supplies

Power supplies may be removed or inserted without powering-down the entire nest. To remove a power supply, first loosen the adjustable grip latch on the upper right-hand corner of the faceplate (shown in Figure 1-5 in Chapter 1); then slide the power supply assembly straight out.

When replacing the assembly, carefully align the metal chassis of the power supply with the tracks inside the nest, and slide it securely into place. Finally, tighten the adjustable grip latch.

Replacing Fans

Fans are accessed from the rear panel of the 2608 8-Modem Nest (see Figure 1-3). To replace a fan, first unplug the wire connector, remove four corner screws from the fan to be replaced, and then remove the fan. It is not necessary to power-down the entire nest.

To reinstall a fan, hold the new fan in position, replace the four corner screws, then reattach the wire connector.

> ***WARNING***
>
> When replacing a fan assembly, avoid putting your fingers inside the nest. Although the connectors in this area are insulated, you may experience a shock if a terminal block or other connector is loose.

SPECIFICATIONS

The environmental limitations, transmit and receive levels, line conditioning requirements, and operating conditions listed in Chapter 1 of the *2600 Series Modem User's Manual* apply to the 2608; however, mechanical dimensions and electrical performance specifications differ in the following areas:

Dimensions and Weight

- Height: 12.22 in. (31.03 cm)
- Width: 19.00 in. (48.26 cm)
- Depth: 18.00 in. (45.72 cm)
- Weight: 92.00 lbs. (41.40 kg), (fully loaded)

Primary Power Requirements

- 115 Vac, 10%, 47 to 63 Hz
- 7.5A (max), 475 watts

Line Fuse Rating

- 3A (Slo-Blo) per power supply

Audio I/O Interface

- To comply with FCC Regulation Part 15, Sub-Part J, only the cables listed below are to be used on the Audio I/O Interface:

Product Code	P/N	Description
31045	53518-01	50-pin 50 ft (15.2m) male to male
31044	53519-01	50-pin 30 ft (9.1m) male to stub
31046	53520-01	50-pin 30 ft (9.1m) male to female

Some applications may require shortening of the male to stub cable (P/N 53519-01). If the cable is to be shortened, lengths of 8 to 16 feet are not permissible due to Radio Frequency Interference (RFI) restrictions. ■ **Note:** The nest occupies 12.25 in. (31.11 cm) of rack height.

PRODUCT CODES

Enclosure

32600	2608 8-Modem Nest Enclosure (does not include power supplies)

Data Pump Cards

32002	2620, 4800 bps Data Pump Card
32003	2640, 9600 bps Data Pump Card
32005	2660, High-speed Data Pump Card

DTE Cards

32001	Single Channel DTE
32004	4-Channel DTE
32006	6-Channel DTE (can be used only in combination with the 32005, 2660 Data Pump)

Power Supply

32007	2608 power supply (one supply powers two modems)

Cables

31044	25 ft (7.6m) 50-pin connector to tinned ends (included with the Nest)
31045	25 ft (7.6m) 50-pin connector to 50-pin connector

2608 8-Modem Nest
User's Guide
Part No. 08155
August 1985

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Please comment on this manual's completeness, accuracy, organization, usability, and readability.

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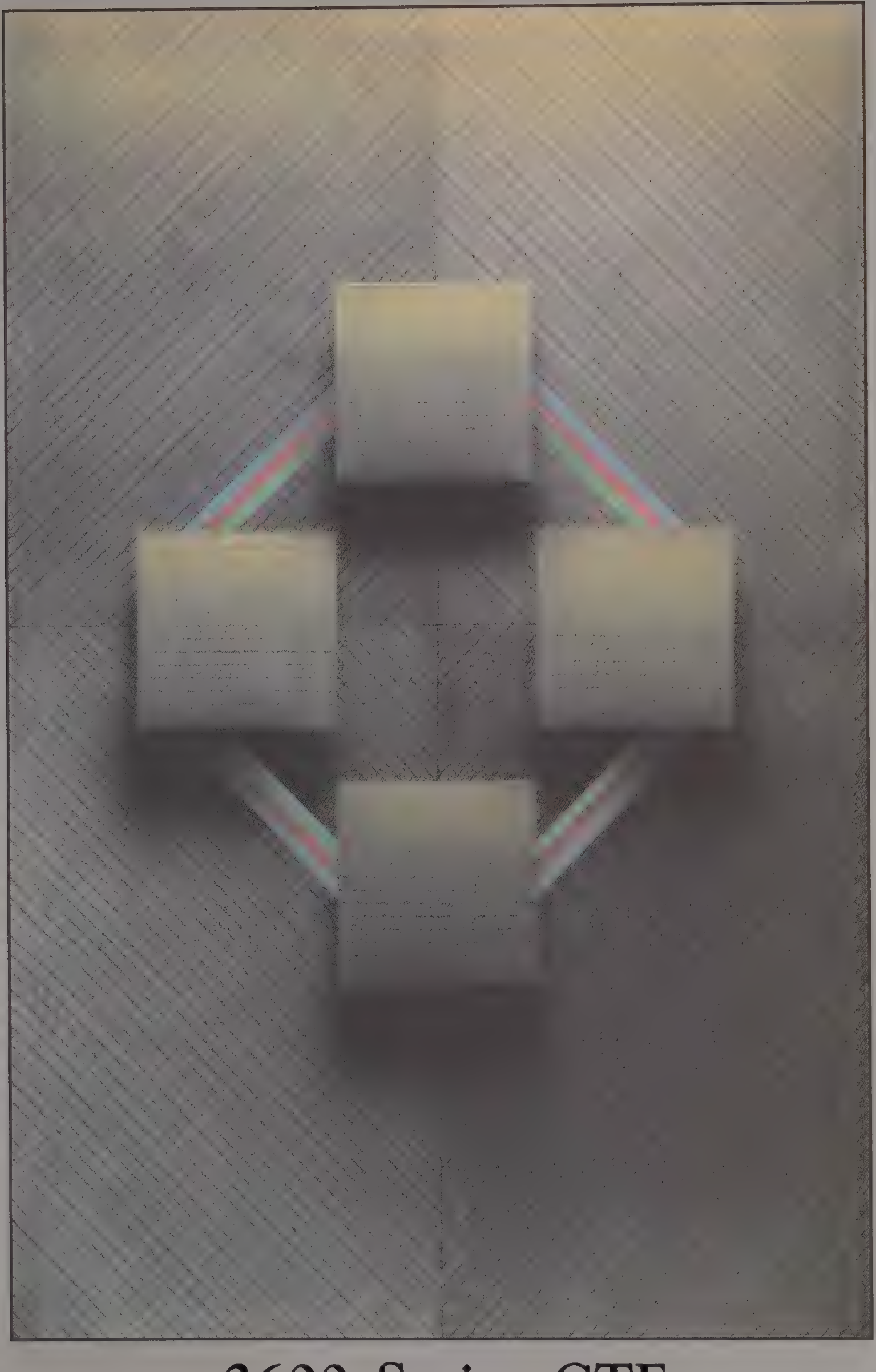

2600 Series CTE
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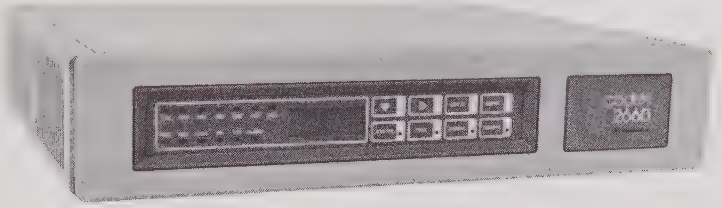

2600 Series CTE
User's Guide

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User Questionnaire

A prepaid user questionnaire is provided in the back of this manual for your comments. Codex welcomes your comments; your input is important in helping us improve the effectiveness of this manual. Thank you.

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

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Contents

Preface iv

Chapter 1. Introduction
Scope of this Document 1-1
Installing the CTE Option 1-2

Chapter 2. Remote Data Scope (RDS)
General 2-1
RDS Features 2-1
  Protocol Support 2-2
  Special Characters 2-2
  Trigger Sequence 2-3
Test Parameters 2-3

Chapter 3. Transmission Impairment Measurement System (TIMS)
Description 3-1
CQMS and TIMS 3-2
Test Sequence 3-2
Interpretation of TIMS Test Results 3-7
  Receive Level 3-7
  Signal-to-Noise Ratio (C-Notched Noise with Tone) 3-7
  Phase Jitter 3-7
  Harmonic Distortion 3-7
  Amplitude Distortion 3-8
  Envelope Delay Distortion 3-8
Modem Calibration 3-8
  TIMS Transmitter Calibration 3-8
  TIMS Receiver Calibration 3-11
  TIMS Calibration Status 3-11

Preface

Communications Test Equipment (CTE) is an option designed for 2600 Series modems that operate as part of the Codex Network Control and Management Systems which include the Distributed Network Control System (DNCS) 200/300 and the 4840/4850/4860 Network Management Systems (NMS).

Chapter 1 provides a description of CTE and its installation.

Chapter 2 discusses the Remote Data Scope (RDS).

Chapter 3 presents a discussion of the Transmission Impairment Measuring System (TIMS), including the calibration procedures necessary to activate the TIMS test sequence.

Chapter 1
Introduction

Contents

Scope of this Document 1-1
Installing the CTE Option 1-2

SCOPE OF THIS DOCUMENT

This guide presents an overview of the Communications Test Equipment (CTE) Option. It includes a general description of two features—the Remote Data Scope (RDS) and Transmission Impairment Measurement System (TIMS)—as they function at a network control site. Chapter 3 also describes calibration procedures that 2600 users must follow if they install the TIMS Option themselves or if the DTE and data pump cards are changed.

Since all operations for the CTE Option must be carried out at the central network management site, more detailed information on CTE operation is available in the operator guides for the 4840/4850/4860 and DNCS 200/300. It is recommended that these network management guides also be reviewed.

Through the CTE Option, both RDS and TIMS provide an accurate method of measuring communication line problems while eliminating the need for expensive, external test equipment. The TIMS test is standardized in accordance with the Bell System Technical Reference No. 41009 and IEEE 743-1984.

All CTE tests must be initiated from a Codex Network Management System, with test results displayed on a corresponding Distributed Network Terminal (DNT) or Network Control Terminal (NCT) video screen. The operator guides for the the 4840/4850/4860 and DNCS 200/300 give details of test operations for use by a network operator. Tests may be run in response to network performance problems or as part of routine maintenance. It is important to note that while the RDS test does not interfere with normal communications, TIMS does suspend communication on the analog line, both main channel and control channel, until the tests are completed (approximately 10 minutes).

INSTALLING THE CTE OPTION

CTE resides on a single printed circuit (PC) card that slides into the bottom slot of any 2600 Series modem. It is available alone, or in combination with the FCC-approved Dual Dial Restoral (DDR) Option. Refer to Chapter 3 of the *2600 Series DDR User's Guide* for information on how to install a PC card that contains both CTE and DDR, or to Chapter 7 of the *2600 Series Modem User's Manual*, if you have ordered CTE alone.

If you have purchased CTE as part of your 2600 Series modem, this PC card has been installed and fully calibrated at the factory; however, if CTE has been ordered separately, some installation will be required and calibration of the TIMS Option will be necessary. Refer to Chapter 3 of this *User's Guide* if calibration is required.

■ **CAUTION:** *If you are planning to use asynchronous or bit-oriented protocols with the 2600 Series CTE Option, do not field-install the option hardware yourself. The CTE Option hardware must be installed by Codex when used with asynchronous protocols.*

To have Codex field-install your CTE Option, contact your local sales representative or customer service office. When you request field installation of your CTE Option, be sure to tell the Codex representative how many DTE ports your modem has.

Chapter 2
Remote Data Scope (RDS)

Contents

General 2-1
RDS Features 2-1
  Protocol Support 2-2
  Special Characters 2-2
  Trigger Sequence 2-3
Test Parameters 2-3

GENERAL

The Remote Data Scope (RDS) feature of the CTE is a qualitative diagnostic tool that assists in identifying communication line problems without interrupting normal operations. RDS isolates and traps main channel data at any given DTE port, and relays a snapshot of that data to the network control central site for display on the operator console.

RDS operates at all speeds, mux modes, and operating modes available in 2600 Series modems.

RDS FEATURES

A remote modem equipped with RDS provides information to the central (network) operator, whether or not supervisory personnel are present at the remote site. Test operations can be monitored and problems diagnosed before sending technical staff to the remote location.

RDS is also useful in confirming the quality of a link before initiating further testing. For example, in a point-to-point link, if the same RDS test is initiated on one modem's transmitter and another modem's receiver, the data collected from the two modems should be identical. By comparing results at the central site (from printouts of the data), the network operator can determine if the link has degraded. The operator may then conduct modem Self tests, BER tests, or a TIMS test to locate and identify the problem.

More than one RDS test can be conducted at the same time on a common line segment, but RDS cannot run simultaneously with other high-speed tests (for example, Bit Error Rate and Poll tests).

Protocol Support

RDS can be used to monitor synchronous lines with byte-oriented (BSC) and bit-oriented (HDLC) protocols, as well as asynchronous lines (see Table 2-1).

RDS supports most synchronous protocols with 8-bit character framing. Most synchronous protocols with seven bits of data and one bit of parity—such as 7-bit ASCII with parity—are supported. When specifying RDS parameters at the Network Management System console, the hex value *including* parity must be specified for synchronous protocols. For asynchronous support, RDS allows you to select strip parity, which not only strips the parity bit from the captured data but also allows the user to specify the hex parameters without parity.

RDS byte-oriented protocol support allows you to specify sync and sync-hunt characters. Your selections are used by RDS to frame messages on both sides. You should select hex "FFFF" for sync-hunt characters, since the pad characters are likely to surround valid data.

A loss-of-sync recovery feature is also part of byte-oriented protocol support. If RDS finds the sync characters within a message but does not find the sync-hunt characters in approximately 5000 character times, RDS reverts to a "search for sync" mode.

Special Characters

A double caret (∧∧) in hexadecimal format or a single caret (∧) in ASCII or EBCDIC formats represents a special character for RDS. RDS inserts these special characters in the 1024-character data buffer to indicate the following occurrences:

> (∧∧) hex: A double caret is used in bit-oriented protocol to indicate a flag (7E). Multiple flags are suppressed automatically.
>
> (∧∧ ∧∧) hex: A double caret pair is used to report either of two conditions. In bit-oriented protocols, it will indicate an "abort" condition (seven or more consecutive "1's"). In all protocols, a double caret pair indicates that the RTS signal on the transmit side or the DCD signal on the receive side has become inactive.

If a control signal change and an abort sequence occur without any characters collected in the interim, only one double caret pair will occur at that point in the buffer.

Since multiple occurrences of flags, aborts, or control signal transitions are not recorded in the data buffer, no more than three double carets can appear consecutively in the buffer. The following two examples explain exactly how this takes place.

Example 1:

- ***Context.*** RDS is monitoring HDLC data on the receive side in a multipoint master. DCD is active when a slave transmits data.
- ***Condition and Result.*** If a slave transmits two consecutive frames in response to a poll, a double caret appears as a frame delimiter. At the end of a second message, three double carets appear, indicating a frame delimiter and a transition of DCD to inactive.

■ **Note:** Any occurrence of a double caret pair in this example would represent an abort condition.

Example 2:

- ***Context.*** RDS is monitoring BSC data on both sides in a high-speed multipoint slave (2650). DCD is always active on the outbound channel from the master. RTS is active only when the slave transmits on the inbound channel to the master.
- ***Condition and Result.*** Since RTS is detected as inactive between separate transmissions, a double caret pair occurs between messages on the transmit side. Since DCD is always active, no caret pairs are displayed on the receive side. Messages are recognized on the receive side by the sync characters and sync-hunt characters.

Note that transitions of RTS or DCD to the inactive state and then back to the active state that occur within 10 milliseconds may not be detected by RDS.

Trigger Sequence

RDS is accessed from the DNCS 200/300 or the 4840/4850/4860 NMS central site, where the operator determines the setup of various RDS parameters such as trigger and protocol type (see Table 2-1). By designating a trigger sequence, for example, the network operator may trap data that is transmitted or received before the trigger point, centered around the trigger point, or after the trigger point. If the operator does not designate a trigger sequence, then a buffer full of data is collected immediately after sync is found. When the test is complete, RDS assembles the trapped data and transfers it to network management through the modem's control channel. The results are then viewed on the console display at the network site in EBCDIC, HEX, or ASCII.

TEST PARAMETERS

Table 2-1 defines parameters that must be specified before the RDS test can be initiated. You will find complete information on how to prepare and perform the RDS test in the Operator Guides for the DNCS 200/300 and the 4840/4850/4860 NMS.

Table 2-1.
RDS Test Parameters

Parameter	*Description*
Sync Character(s)	Programmable 1- or 2-character sync field. RDS will not trap any data until the sync sequence is found. This feature is used for byte-oriented protocols only.[1]
Sync-Hunt Character(s)	Programmable 1- or 2-character field. When RDS encounters the programmed character sequence, it begins looking for sync again, preventing in-between message pad characters from appearing in the data buffer. This feature is used for byte-oriented protocols only.[1]
Character Suppression	Programmable feature used to suppress two or more consecutive occurrences of any character to one. May be used for all protocols.
Trigger Sequence and Placement	A programmable string of characters used to activate the RDS test. Once the trigger sequence is found, a network alarm occurs (if the alarm monitor is enabled) and RDS determines how much more data must be placed into the buffer. The buffer can then be returned to network control with the trigger sequence properly located. The trigger may be located at the beginning, center, or end of the character buffer. RDS does not look for the trigger sequence until the sync has been found.
NRZI Enable/Disable	NRZI is used to ensure that the RDS and terminal configurations are the same. Used with either BSC-like protocols or more typically with HDLC-like protocols.
Strip Parity	Strip parity is used to ensure the RDS and terminal port configurations are the same when supporting an asynchronous protocol. If it is determined that the data includes a parity bit, stripping parity allows the network operator to specify the trigger sequence and the other character-specific parameters without calculating the parity bit for each parameter. (Enabling strip parity when no parity bit is encoded in the data results in an invalid RDS test.)[2]
Protocol Type	Selected as asynchronous, byte-oriented synchronous, or bit-oriented synchronous.
Data Path Monitoring (Test Mode)	Selected as receive data monitoring, or transmit data monitoring, or both (full-duplex). An error message is returned when modem speeds exceed the RDS full-duplex capability of 9600 bps, *except* when byte-oriented protocols are selected. With Data Path Monitoring, a quasi full-duplex capability exists in which one side is monitored until the trigger is found. Then data from both sides is collected until the buffer is full. (This is used with trigger positioning at the beginning or center, but not when the trigger is at the end.)[3] When RDS is used at 19.2 kbps and byte-oriented synchronous data is being trapped, the quasi full-duplex feature is not enabled. Data will only be trapped on the side with trigger enabled.
Port	The DTE port selected for monitoring.

---

[1] Bit deletion is automatically enabled and RDS synchronizes on 7E for bit synchronous protocols. Therefore, this field is not required when a bit synchronous protocol has been selected.

[2] RDS takes advantage of internal data to know the number of information bits per character. The network control operator does not have to enter character length and data rate as parameters.

[3] When the trigger is specified in the beginning of the buffer and monitoring is performed in full-duplex mode, the entire trigger sequence may not appear in the buffer. One character from the beginning of the trigger will be lost for each character from the opposite direction collected during the time the trigger sequence itself is collected.

Chapter 3
Transmission Impairment Measurement System (TIMS)

Contents

Description 3-1
CQMS and TIMS 3-2
Test Sequence 3-2
Interpretation of TIMS Test Results 3-7
  Receive Level 3-7
  Signal-to-Noise Ratio (C-Notched Noise with Tone) 3-7
  Phase Jitter 3-7
  Harmonic Distortion 3-7
  Amplitude Distortion 3-8
  Envelope Delay Distortion 3-8
Modem Calibration 3-8
  TIMS Transmitter Calibration 3-8
  TIMS Receiver Calibration 3-11
  TIMS Calibration Status 3-11

DESCRIPTION

The Transmission Impairment Measurement System (TIMS) feature of the CTE is available only through Network Control and Management Systems (DNCS 200/300 and NMS 4840/4850/4860). TIMS measures critical telephone line characteristics by performing an analog ''line sweep'' on the circuit between two 2600 Series modems. The results of this test are then compared to the tariffed telephone line parameters to determine if the line is functioning within specifications.

TIMS is initiated generally in response to network performance problems or after the Circuit Quality Monitoring System (CQMS) alarms indicate that the quality of a specific circuit is deteriorating; however, it may also be run as part of a normal network maintenance routine. TIMS tests are initiated and measurements are displayed on the operator consoles.

CQMS AND TIMS

The 2600 CQMS continuously monitors circuit analog characteristics during your normal data transmission, giving advance warning of analog line degradation. An advantage of CQMS is that the procedure does not interfere with the transmission of data. However, its results are not as accurate as the TIMS test.

CQMS measurements are obtained from the data signal after it has been processed through the modem's receive equalizer. The receive equalizer inside the modem compensates for some of the channel degradations, but at the same time it distorts the effect of some channel characteristics before CQMS can actually measure the quality of the received signal. Therefore, while CQMS is a valuable tool for constant line monitoring and alarm signaling, its results may not be entirely accurate. Further, since CQMS test estimates are not obtained in accordance with the industry-accepted standard, Bell System Technical Reference No. 41009, you may experience difficulty convincing the telephone company that a CQMS degradation exists or that the measurements reported by CQMS are correct.

Because TIMS conforms to industry-accepted test methods, TIMS test results measure analog degradation according to the line-tariff parameters established by the telephone company. The TIMS test suspends normal data communication on the modem main channel as well as all communication on the control channel for the duration of the test (approximately 10 minutes). It is normal for the slave and all modems downstream from the segment being tested to report "No Response" to the central network control site during the test. (These modems automatically return to normal when the test is completed.)

Because TIMS runs between the master or central site modem and only one slave or remote modem, the remaining 2600 slave modems will shut down for the duration of the test to avoid interpreting the TIMS sweep as data. Non-2600 modems, usually CS48FPs, will not shut down automatically. Using the Network Management System Disconnect/Restore function, you must disconnect the main audio channels for those modems prior to the test and restore them after the test.

TEST SEQUENCE

The TIMS Option performs the following standard quantitative tests:

- Receive Level
- Signal-to-Noise Ratio
- Phase Jitter
- Harmonic Distortion
- Amplitude Distortion
- Envelope Delay Distortion

The testing sequence is shown in Table 3-1. The sequence is automatic and cannot be controlled or selected once testing has begun. The accuracy and acceptable ranges of the TIMS test results are shown in Table 3-2.

■ **Notes:** 1) You cannot run a TIMS Test while the modem is operating with Dual Dial Restoral.

2) When you initiate and collect results for a TIMS Test on 2680 Modems, a fallback rate of 12.0 kbps is recommended. Since the control channel on 2680 Modems is embedded, it is more susceptible to line impairments or distortions. Operating a fallback rate on the 2680 will facilitate the installation of CTE (Communications Test Equipment) and of operation commands that must pass over the control channel.

Table 3-1.
2600 Series TIMS Option Test Sequence

Step	*Network Controller*	*Modem A*	*Modem B*
1)	–	Passes data.	Passes data.
2)	Sends TIMS command to Modems A and B.	Passes data and accepts command.	Passes data and accepts command.
3)	Requests test status from Modem A until test is "done."	Passes data and delay.	Passes data and delay.
4)	–	Shuts down data and secondary channel.	Shuts down data and secondary channel.
5)	–	Loads first set of TIMS programs into signal processor.	Loads first set of TIMS programs into signal processor.
6)	–	Transmits 1004 Hz tone. Receives 1004 Hz tone. Measures SNR. Measures phase jitter. Stops 1004 Hz tone and waits.	Transmits 1004 Hz tone. Receives 1004 Hz tone. Measures SNR. Measures phase jitter. Stops 1004 Hz tone and waits.
7)	–	Transmits 1004 Hz tone. Sweeps tone sequence. Measures amplitude distortion at each frequency. Stops frequency sweep.	Transmits 1004 Hz tone. Sweeps tone sequence. Measures amplitude distortion at each frequency. Stops frequency sweep.
8)	–	Loads second set of TIMS programs into signal processor.	Loads second set of TIMS programs into signal processor.
9)	–	Starts 83-1/3 AM frequency sweep. Measures envelope delay for each frequency. Stops 83-1/3 AM frequency sweep.	Retransmits modulated 1800 Hz tone.
10)	–	Retransmits modulated 1800 Hz tone. Stops retransmitting modulated 1800 Hz tone.	Starts 83-1/3 AM frequency sweep. Measures envelope delay for each frequency. Stops the 83-1/3 AM frequency sweep.
11)	–	Transmits sequence of harmonic distortion calibration tones. Calibrates harmonic distortion. Transmits harmonic test tones. Measures harmonic distortion. Stops harmonic distortion test tone sequence.	Transmits sequence of harmonic distortion calibration tones. Calibrates harmonic distortion. Transmits harmonic test tones. Measures harmonic distortion. Stops harmonic distortion test tone sequence.
12)	–	Loads modem software into signal processor.	Loads modem software into signal processor.

(continued on next page)

Table 3-1 (continued).
2600 Series TIMS Option Test Sequence

Step	*Network Controller*	*Modem A*	*Modem B*
13)	–	Starts passing data and restores secondary channel.	Starts passing data and restores secondary channel.
14)	–	Passes data and responds to network controller that the test is done.	Passes data.
15)	Requests test results from Modem A.	Passes data and reports results.	Passes data.
16)	Requests test results from Modem B.	Passes data.	Passes data and reports results.
17)	Displays TIMS test results to operator.	Passes data.	Passes data.

Table 3-2.
2600 TIMS Option Specification

Transmitter	*Receiver*
These measurements are designed in accordance with Bell System Technical Reference 41009 and IEEE 743-1984.	
Receive Level	
Transmitter Level: 0 dBm ±0.2 dB	Receive Level Range: −30 to 0 dBm
Frequency: 1004 Hz ±1.0 Hz	Resolution: 0.1 dB
Distortion: −40 dB Maximum	Accuracy: ±0.5 dB
Signal to Noise Ratio (noise with tone)	
Transmitter Level: 0 dBm ±0.2 dB	Minimum Receive Level Range: −25 dBm
Frequency: 1004 Hz ±1.0 Hz	SNR Ratio Range: 22 to 35 dB
Distortion: −40 dB Maximum	Resolution: 1 dB
	Accuracy: ±1 dB
Phase Jitter	
Transmitter Level: 0 dBm ±0.2 dB	Minimum Receive Level Range: −25 dBm
Frequency: 1004 Hz ±1.0 Hz	Jitter Range (Peak to Peak): 0° to 30°
Distortion: −40 dB Maximum	Resolution: 0.1°
	Bandwidths: 20 to 300 Hz 4 to 300 Hz 4 to 20 Hz
	Accuracy: ±10% ±1.0°
■ **Note:** Most measurement devices have filter frequency tolerances that make them unable to reject phase jitter near the band edges. Therefore, out-of-band phase jitter may not meet this specification.	
Harmonic Distortion (both second and third order harmonics)	
Transmitter Level: 0 dBm ±0.2 dB	Minimum Receive Level Range: −25 dBm
Distortion: −40 dB Maximum	Range: 25 to 45 dB
	Resolution: 1 dB
	Accuracy: ±3 dB
	Minimum SNR: 24 dB

■ **Notes:** 1) TIMS test results (notably SNR) are affected by the presence of echoes on the line.

2) Invalid test results after a TIMS test can mean that the test could not be completed due to extreme line conditions. (All other results remain valid.)

3) Although results outside the above ranges are displayed without clipping (adjusting the display to keep at maximum/minimum values), their accuracy is not guaranteed.

4) Impedance of the circuit under testing is 600 ohms *only,* and is not selectable.

5) The Environmental Requirements for stated accuracy are:
Operating Temperature Range: 32° to +104°F (0° to +40°C)
Minimum Warm-up Time: 10 minutes.

(continued on next page)

Table 3-2 (continued).
2600 TIMS Option Specification

Transmitter	*Receiver*
These measurements are designed in accordance with Bell System Technical Reference 41009 and IEEE 743-1984.	
Amplitude Distortion	
Transmitter Level: 0 dBm ±0.2 dB	Frequency Range: 504 to 3304 Hz
Distortion: −40 dB Maximum	Distortion (Relative to 1004 Hz) Resolution: 0.1 dB Accuracy: ±0.6 dB
Signal Frequency (SF) Skip: Skips a band from 2450 to 2750 Hz	Minimum SNR: 20 dB
	Minimum Receive Level at each frequency for valid amplitude distortion measurement: −30 dBm
Envelope Delay	
Transmitter Level: 0 dBm ±0.2 dB	Frequency Range: 504 to 3304 Hz (2680 only) 604 to 3204 Hz (all other models)
Distortion: −40 dB Maximum	Range: −3000 μsec to +9000 μsec
Modulation: 83-1/3 Hz	Resolution: 1 μsec
Return Frequency: 1800 Hz	Minimum SNR: 24 dB
SF Skip: Skips a band from 2450 to 2750 Hz	Accuracy: ±50 μsec *
	Minimum Receive Level at each frequency for valid envelope delay measurement: −30 dBm

*The CTE Envelope Delay Test accuracy is ±150 μsec where the amplitude distortion characteristics across 200 Hz differ by more than 3 dB. Envelope delay results at very low levels (less than −40 dBm) cannot be measured at all.

■ **Notes:** 1) TIMS test results (notably SNR) are affected by the presence of echoes on the line.

2) Invalid test results after a TIMS test can mean that the test could not be completed due to extreme line conditions. (All other results remain valid.)

3) Although results outside the above ranges are displayed without clipping (adjusting the display to keep at maximum/minimum values), their accuracy is not guaranteed.

4) Impedance of the circuit under testing is 600 ohms *only,* and is not selectable.

5) The Environmental Requirements for stated accuracy are:
Operating Temperature Range: 32° to +104°F (0° to +40°C)
Minimum Warm-up Time: 10 minutes.

INTERPRETATION OF TIMS TEST RESULTS

It is important to interpret the TIMS test results in a specific order to obtain the most accurate picture of the analog line performance. The presence of some line impairments will affect the ability to measure other impairments correctly. The network operator must observe the first four test results in sequence *before* checking any others.

Invalid test results after a TIMS Test can mean one or both of the following:

- The test could not be completed due to extreme line conditions. (All other results remain valid.)
- Envelope delay results at very low levels (less than −40 dBm) cannot be measured at all.

Receive Level

Check this result first. The receive level test measures the extent of power loss in a signal as it moves along a transmission path. If the overall line attenuation (loss) is outside tariff specifications, resulting in a receive level for a 1004 Hz tone that is above −12 dBm or below −20 dBm, report that the circuit problem is either a high or low receive level.

The other TIMS test results cannot be accurately determined in the presence of an abnormally low receive level. Have the telephone company repair this problem first. Then run TIMS again to obtain new readings for the other tests in the sequence.

Signal-to-Noise Ratio (C-Notched Noise with Tone)

This result should be checked next. C-notched noise is a measure of the amount of noise on the line when a signal is present. A 1004 Hz tone is applied at the transmitting end of the channel, simulating a data signal. The tone is removed at the receiving end by a narrow band elimination filter (called a notch filter), and the noise is then measured through a C-message filter. The ratio of the received 1004 Hz test tone signal to the power of C-notched noise indicates the signal-to-noise ratio on the line; in turn, the signal-to-noise ratio indicates overall line quality.

A C-message filter is used for measuring noise because it is the standard for reporting noise to the telephone company. Some measurement instruments also use 3-K Flat, 15-K Flat, and Program filters, but these filters do not apply to Voice Frequency (VF) channels and are therefore not tariffed.

Some measurement instruments measure and report C-Notched Noise with Tone. This can be derived from the results of the Signal-to-Noise Ratio test together with the Receive Level test. First, add the Receive Level test result to the Signal-to-Noise test result (SNR + RCVL). This yields a number in dBm. Since C-Notched Noise with Tone is a measure of noise in dBrn, you must then convert the dBm measurement to dBrn. To do this, subtract the dBm number from 90.

If the overall signal-to-noise ratio is outside tariff specifications (below 24 dB *or* below 28 dB for D1 conditioned lines), report that the circuit problem is noise. The other TIMS test results cannot be accurately measured in the presence of an abnormally low SNR. Have this problem corrected and run the TIMS again to obtain new readings for the remaining tests.

Phase Jitter

This result should be checked third. Any periodic change in the phase of a transmitted signal constitutes phase jitter. The receiver sends the phase error of the 1004 Hz test tone through three separate filters to measure phase jitter at 20 to 300 Hz, 4 to 300 Hz, and 4 to 20 Hz. ■ **Note:** If the total phase jitter for 20 to 300 Hz is outside telephone company guidelines of 10 degrees peak-to-peak, report the problem as phase jitter. Observe that test results may be affected by large amounts of amplitude modulation (which the TIMS Option does not measure); however, phase jitter impairments do not affect the measurement accuracy of any other TIMS test.

Harmonic Distortion

This result should be checked fourth. Harmonic distortion occurs when attenuation of the receive level varies with the amplitude of the signal (e.g., a 1V signal may be attenuated by one-half, while a 5V signal may be attenuated by two-thirds). In this way, the signal may be flattened at the peaks, which is equivalent to adding low amplitude harmonics. This is called harmonic distortion and is measured according to the relative degree of second and third order harmonics (two and three times the standard frequency, respectively).

If the results of this test do not match tariff specifications, report the problem as harmonic distortion. Impairments created by harmonic distortion do not affect the measurement accuracy of any other TIMS test result.

Once the first four test results meet tariff specification requirements, the network operator will display and interpret the Amplitude and Envelope Delay Distortion test results to complete the test sequence.

Amplitude Distortion

Check this result before looking at the Envelope Delay Distortion. Amplitude Distortion occurs when the amplitudes of some frequencies are attenuated (reduced) more than others by the transmission path. If the amplitude at any specific frequency (relative to 1004 Hz) is outside tariff requirements for the specified C-conditioning, report that the circuit problem is amplitude distortion and state the specific frequencies involved. Since TIMS will not measure envelope delay at frequencies where the amplitude is too low, have this problem corrected before you run and interpret the Envelope Delay Distortion test.

Envelope Delay Distortion

This is the final result to be checked. In envelope delay some frequencies may arrive at the receiver before or after other frequencies; center frequencies tend to arrive sooner than those at the outer edges of the bandwidth. This condition causes "intersymbol interference," making it difficult for the receiver to distinguish between various incoming data symbols.

If the envelope delay (relative to 1800 Hz) at any specific frequency lies outside tariff specifications, report that the circuit problem is envelope delay distortion and state the specific frequencies involved.
■ **Note:** This test depends on having sufficient signal amplitude at each measured frequency. Results are suppressed when the amplitude at any frequency is too low for the measurement to be made.

Frequencies of 504 Hz and 3304 Hz are currently reserved for future use. These frequencies will always be suppressed in the Envelope Delay test results. Envelope delay impairments do not affect the measurement accuracy of any other test result.

Only C0, C1, C2, and D1 line specifications are used for comparison during the test sequence, because these lines represent the only levels of conditioning required for operation of 2600 Series modems.

MODEM CALIBRATION

Manual calibration of the specific modem transmitter and receiver is required to meet the stated accuracy of the TIMS test (see Table 3-2). The TIMS modem calibration is for TIMS operation only, and has no effect on any other modem function.

A modem that contains a factory-installed CTE Option will arrive fully calibrated. If, however, the CTE Option is installed as a separate item, or if you replace the Data Pump or DTE card, TIMS calibration must be carried out. Likewise, since the transmitter and receiver calibration values are saved in the modem's nonvolatile configuration memory, if you clear the configuration memory ("CLR CFM" command of the Configuration Tree), the calibration values will be lost and the modem will need to be recalibrated.

Calibration procedures must be carried out through the local modem Control Panel. The TIMS calibration cannot be done using either network control management systems or a remote Control Panel.
■ **Note:** Main channel communications are disrupted by calibration procedures.

Once the CTE Option is installed in your 2600 unit, the TIMS* category is automatically added to the Configuration Tree. (See the Configuration Tree section of Chapter 4 of the *2600 Series User's Manual* for explanations of the remaining categories.) Figure 3-1 indicates the calibration procedures to be followed by moving through the TIMS* Category.

TIMS Transmitter Calibration

The TIMS transmitter calibration is used to set the gain for generating TIMS test tones at 0 dBm ±0.2 dBm. *You must perform the transmitter calibration before the receiver calibration.* The accuracy of the receiver calibration depends on this step.

To begin transmitter calibration, you need to establish a connection with twisted pair wire from the modem to a power meter. This connection can be made from the modem terminal block or from the point an external TIMS could be attached. *The power meter must have a 600-ohm termination and must be accurate to ±0.2 dBm.*

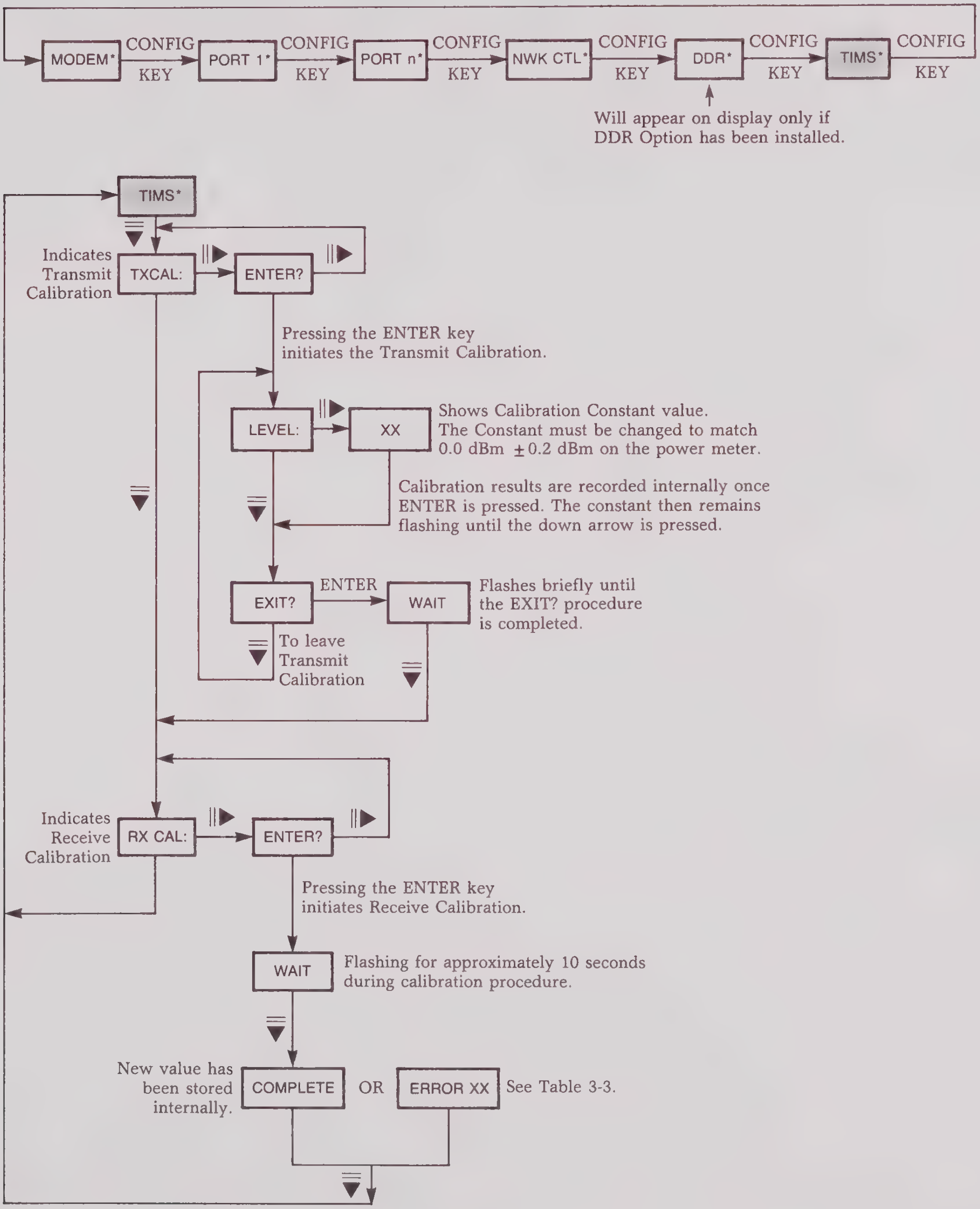
MODEM*
CONFIG KEY
PORT 1*
CONFIG KEY
PORT n*
CONFIG KEY
NWK CTL*
CONFIG KEY
DDR*
CONFIG KEY
TIMS*
CONFIG KEY
Will appear on display only if DDR Option has been installed.
TIMS*
Indicates Transmit Calibration
TXCAL:
ENTER?
Pressing the ENTER key initiates the Transmit Calibration.
LEVEL:
XX
Shows Calibration Constant value. The Constant must be changed to match 0.0 dBm ±0.2 dBm on the power meter.
Calibration results are recorded internally once ENTER is pressed. The constant then remains flashing until the down arrow is pressed.
EXIT?
ENTER
WAIT
Flashes briefly until the EXIT? procedure is completed.
To leave Transmit Calibration
Indicates Receive Calibration
RX CAL:
ENTER?
Pressing the ENTER key initiates Receive Calibration.
WAIT
Flashing for approximately 10 seconds during calibration procedure.
New value has been stored internally.
COMPLETE
OR
ERROR XX
See Table 3-3.

Figure 3-1. TIMS Configuration Tree

You initiate the TIMS Transmitter calibration from the Control Panel and then select numeric values on the Control Panel until you obtain a readout of 0.0 dBm on the power meter. The modem will save the last entered numeric value in nonvolatile memory, and will use this value to set the correct transmit level for the TIMS test tones. Proceed according to the following sequence:

1) Before initiating TIMS calibration, enter the "OVERRIDE:" subcategory of the Remote Tree and select ENABLE to activate the override function, to avoid Control Panel error messages during the TIMS test sequence.
2) From the Control Panel, enter the TIMS* category of the Configuration Tree.
3) Scroll down to the "TXCAL:" subcategory and press the ||▶ key to get "ENTER?". Then press the ENTER key to begin the transmitter calibration test. ■ **Note:** Modulation will be interrupted as soon as the ENTER key is selected.
4) When "LEVEL" appears, press the ||▶ key to view the calibration constant. A numeric value (e.g., 64) should appear on the display.
5) Change the calibration constant until the level on the dB meter reads "0.0 dBm", ±0.2 dBm. (To change the constant, see the section on procedures for numerical data entry in Chapter 4 of the *2600 Series Modem User's Manual*.)
6) Press the ENTER key. The transmit level will change and be recorded internally each time (and only when) the ENTER key is pressed.
7) To exit from this configuration, press the ▼ key and "EXIT?" will appear on the display. Press the ENTER key, which will cause "WAIT" to flash briefly, until the exit procedure is completed.

Table 3-3.
TIMS Receiver Calibration Errors

Error Message	*Source*	*Action*
10	1004 Hz tone not detected.	Check the attachment of the modem transmitter to the receiver.
11	Modem transmitter not calibrated for TIMS.	Calibrate transmitter before calibrating the receiver.

TIMS Receiver Calibration

TIMS Receiver Calibration is used to calibrate the TIMS receiver to determine the internal path loss between the receiver terminal block and the receive level measuring device. *You must calibrate the TIMS modem transmitter prior to calibrating the receiver.*

To begin receiver calibration, you must establish a loopback connection with a twisted wire pair from the modem receiver to the modem transmitter. This loopback can be done at the modem terminal block or at the point where an external TIMS would be attached. ■ **Note:** You cannot use Modem Check for this loopback.

You initiate the TIMS receiver calibration from the Control Panel of the modem. TIMS reads the receive level and automatically calibrates itself to account for the internal path loss. The modem will save this calibration value in nonvolatile memory and use it during TIMS Receive Level measurements.

1) From the Control Panel, enter the TIMS* category of the Configuration Tree.

2) Scroll down to the "RXCAL:" subcategory and then across to "ENTER?". Press the ENTER key to begin the receiver calibration test. ■ **Note:** Modulation will be interrupted as soon as the ENTER key is selected.

   "WAIT" will flash for approximately 10 seconds during calibration.

   If "COMPLETE" appears on the display, the new value has been stored internally. If "ERROR XX" appears, see Table 3-3. ■ **Note:** There will be no change in the value of the internal receiver calibration constant on "ERROR."

3) Again enter the "OVERRIDE:" subcategory of the Remote Tree and select DISABLE to cancel the override function, so that network control functions can resume.

TIMS Calibration Status

The TIMS transmitter and receiver calibration status can be observed without disrupting main channel operation.

Go to the TIMS*/TXCAL: subcategory of the Configuration Tree and observe the Control Panel display. If "TXCAL:" is flashing, the TIMS modem transmitter has been calibrated. If "TXCAL:" is not flashing, calibration is required. The same process applies when you observe "RXCAL:" on the Control Panel display.

Whenever the DTE or DP boards are changed for any reason, TIMS requires recalibration. If a flashing display of either "TXCAL:" or "RXCAL:" appears on the Control Panel of the modem, it will not accurately indicate the status of calibration unless recalibration has been performed.

2600 Series CTE
User's Guide
Part No. 08174, Rev B
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